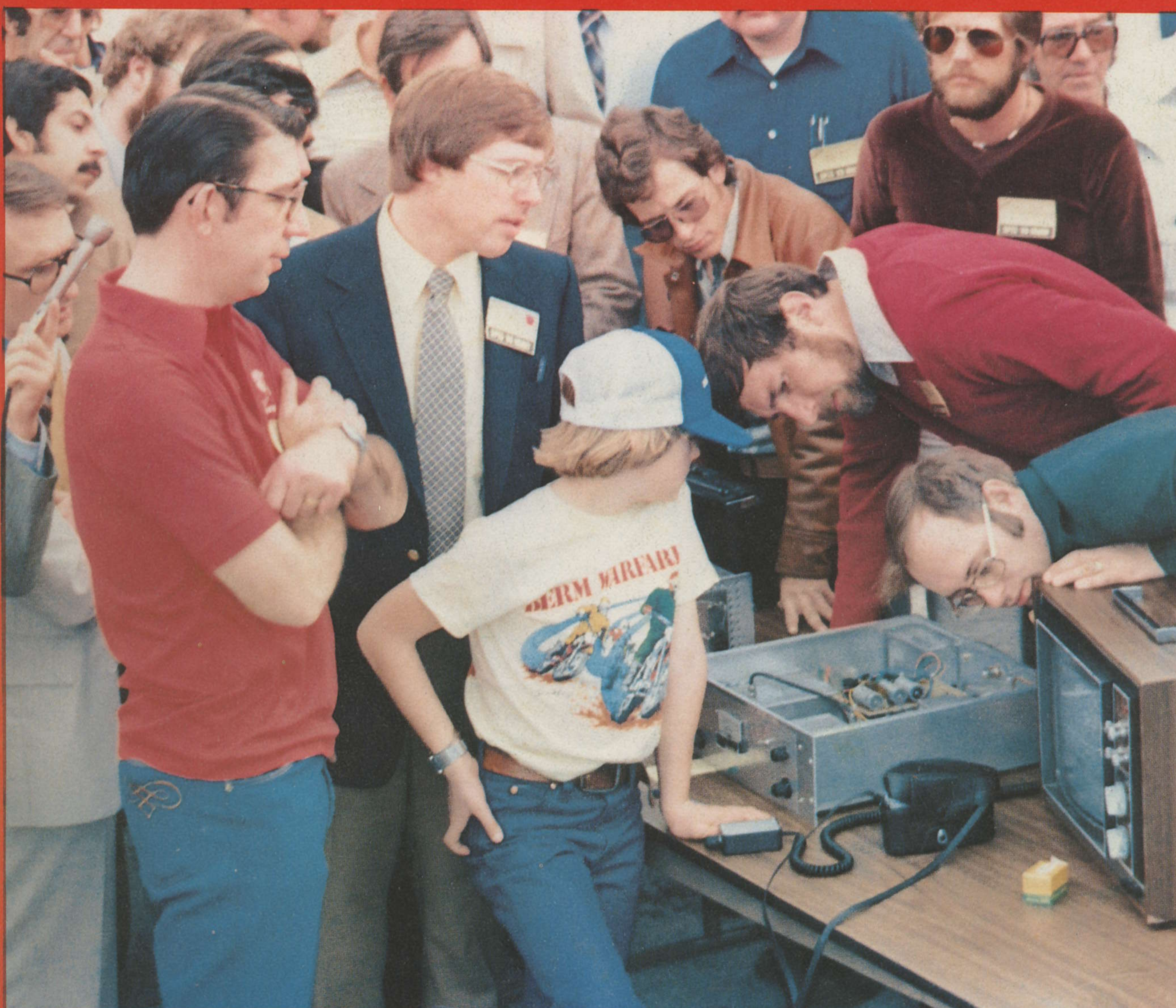
SAMPLE

PS. 9

INSIDE THIS ISSUE

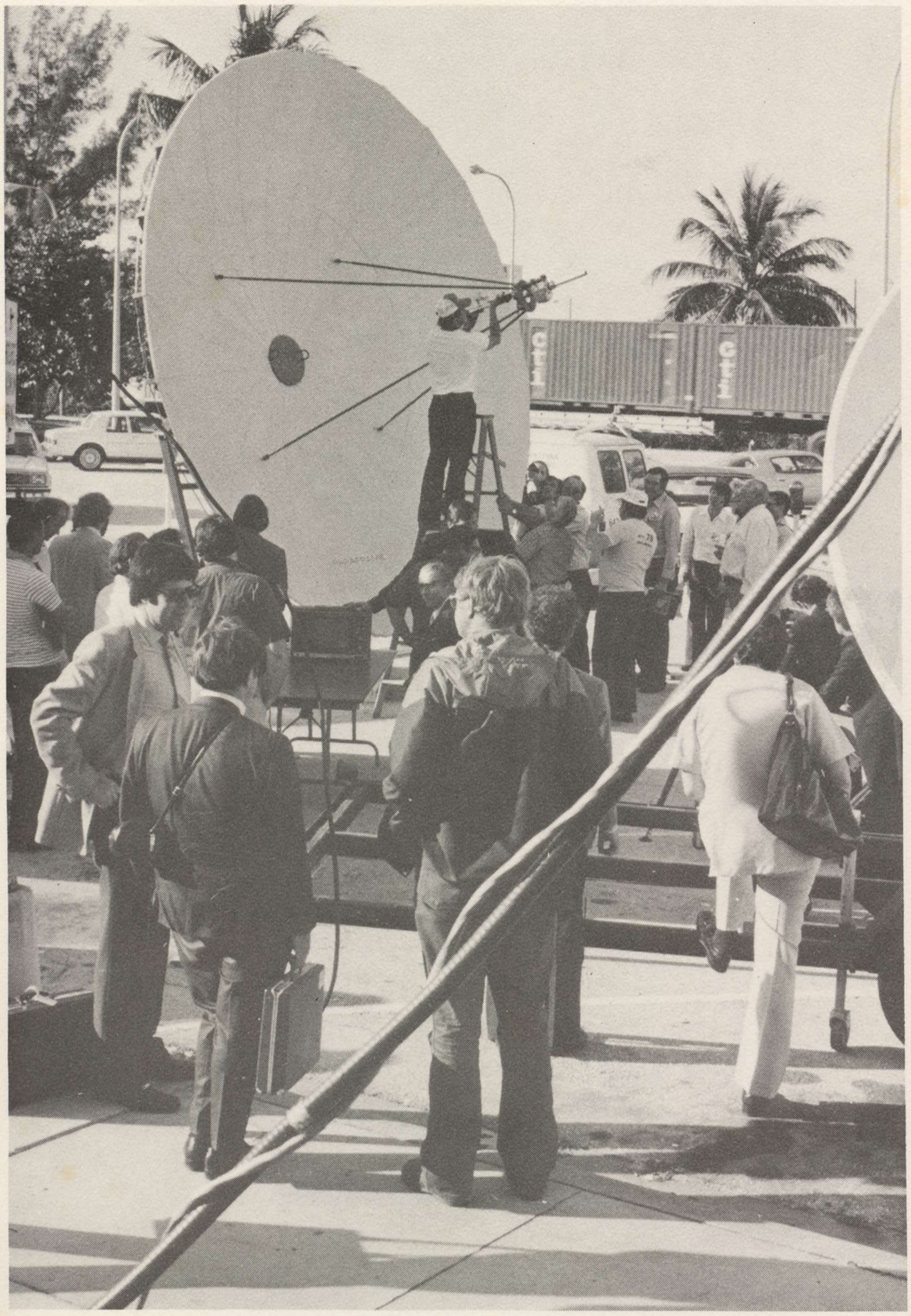
COOP'S SATELLITE DIGEST

APRIL 1980



AWESTRUCK BY INTELSAT - The first public display of INTELSAT reception on a small [4 meter] antenna draws an intense SPTS crowd bunched around a Sony monitor fed by an AVCOM receiver. "MY GOD - that's a soccer match from BRAZIL!!!"

PARAFRAME



INTELSAT. If you are planning to work with EIRPs as low as INTELSAT's 26 dBw hemispheric beam, you need the high precision, structural strength and clean-gain of a BIG ONE from Paraframe. At Paraframe we do the big jobs every day; 12 foot, 15.9 foot and soon 24 foot high performance parabolas.
INTELSAT. The real test of a small system private terminal. At Miami's SPTS '80 the big ET/4.85 (15.9') high-precision parabolic by Paraframe delivered the impossible; Sao Paulo, Brazil via Intelsat IV-A (FI) parked over the Atlantic at 24.5 degrees west!

INTELSAT IV-A [FI]/Sao Paulo/At SPTS '80

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COOP'S COMMENT ON TECHNOLOGY

SPTS '80 CALIFORNIA

While it may not be apparent to the casual observer, there has been an attempt on our part to 'package' the SPTS events to suit the locale where they are held and the mood of the industry at that point in time. The technical and non-technical sessions, for example, are kept 'fluid' right up to the last ten days or so to insure that we have the latest developments and technology on the program.

SPTS '80/California is now firmly set on the calendar. The dates are July 4, 5 and 6; a Friday, Saturday and Sunday. Yes, that is over a holiday period and we think this is smart since it will allow more people to get away and attend.

SPTS '80/California is being held in San Jose, California which for the unwashed is deep in the heart of something insiders call 'Silicon Valley'. The Sunnyvale/Santa Clara/San Jose portion of the southern San Francisco Bay houses a very high percentage of the nation's high technology (i.e. space electronics) firms and we suspect that you could get yourself a tour or two of some of these facilities just before or after SPTS '80 if you played your cards right.

Now to show that Susan and I **do listen** to your comments, suggestions and complaints here is how SPTS '80/California will adapt to the location, the timing of the event and the spirit of SPTS.

1) The location for everything is the San Jose Hyatt House. This is less than 5 minutes from the San Jose Airport (which is easy to get into and out of from almost anyplace) and if you insist on coming in from San Francisco's larger airport, a 40 minute or so drive straight down the Bayshore freeway.
2) The Hyatt House's main facility will seat 1,000 people; which we'll split up between parallel high-technology and low-technology/management/equipment sessions.
3) The physical layout of the Hyatt House offers us a unique opportunity to do everything at one spot. A large central Japanese garden is surrounded by lodging facilities and we will have the booths within the garden area (many will be outside!); at least one antenna will be 'poolside' and you'll move from booth to booth by walking through the garden (now that's California for you!).
4) We always videotape the presentations. **THIS** time we'll take the day's videotapes and run them back through the Hyatt's MATV system so you can **sit in your room** in the evenings and watch (or re-attend) the day's events. **YES** - you **can bring** your own VCR machine, set it up in your Hyatt House room and videotape the proceedings to take back home with you! This way you can attend both the technical and not so technical sessions every day; one program in person, the other on tape!
5) The heavy sessions will be on Friday the 4th and Sunday the 6th (we'll be done at 3 PM on the 6th). Since essentially the whole facility will be 'ours' for the holiday weekend, we can operate with hours and scheduling that might disturb others; such as well into the evening periods. Saturday the 5th will be Exhibit Day and for the most part this will be your opportunity to really get acquainted with the suppliers and their gear.
6) This will be an informal affair, ties and suits (in respect to the California life style) are definitely out. We'll even let you into sessions wearing a swimming suit (provided you have your badge on or with you).

The family. The San Jose area has numerous nifty attractions including Marriott's Great America Theme Park (ten minutes from the Hyatt) and Frontier Village. The Santa Cruz beach and boardwalk is nearby. There is no shortage of attractions for the family while the 'old man' soaks up the latest in satellite technology.

We recall that the SPTS '79 in Oklahoma last August sold out weeks in advance. Interest in the San Jose SPTS is so high that we expect two things to happen within a short period of time. **First**, the booth space for exhibitors (there is only so much available) will disappear very rapidly. We've made a mailing to the exhibitors already and if you want to exhibit but didn't get an announcement from us you'd better get back to us pronto; many of the best spots are already gone. **Second**, although the Hyatt House has 500 sleeping rooms we expect them to disappear rapidly since staying there will assure you of being in the thick of the action, plus, give you direct access to the televised events through the MATV system in the facility. **Don't contact the Hyatt directly however**; we have special registration cards that we return to you with confirmation of your registration that not only gets you in but also gets you a break in rates ($36 single/$38 double; compare that to Miami!)

Check your calendar and make your plans now. Use the registration card in this issue of CSD. Today. **Now.**

OUR COVER-

As the first hint of INTELSAT from Brazil climbs through the sparklies a moment of silence falls over the SPTS '80/Miami crowd.

CSD

TECHNOLOGY

COOP'S SATELLITE DIGEST (Technology Section) is produced monthly by Satellite Television Technology, P. O. Box G, Arcadia, Oklahoma 73007 (USA); 405-396-2574. **CSD** is not affiliated with any satellite programming source, hardware (equipment) manufacturer or distributor, nor satellite systems operator. STT does produce a weekly television program called **Satellite Magazine** which is distributed free of charge to viewers via RCA SATCOM FI at 12 noon eastern, Thursdays on (SPN) transponder 21. Subscription rates to **CSD** are $50 per year for US, Canada an Mexico delivery; $75 per year outside (all via first-class/airmail). All subscriptions must be paid in advance; no invoicing.

LEARN BY DOING NEW PLL TRICKS

THE PLL DISCRIMINATOR GOODIE

The utilization of the Phase Lock Loop, primarily the NE561 and NE564 to date, has been abundantly described by Tay Howard and Steve Birkill in both manuals and here in **CSD**. The Probability that not all of the tricks of the PLL, as an FM detection system, are known to mankind has prompted Canadian research engineer Jan Spisar to investigate further methods of improving the sensitivity and stability of these popular devices.

While the introduction of the Washburn Manual with its clever use of Plessey PLL devices suggests that there are still engineering tricks to be played effectively with the Plessey devices, the mainstay of most PLL circuits in North America remains the NE561 and 564 devices. There are rumors that the 561 may be dropped from the line sometime soon leaving the 564 as the 'winner device' in this series. The primary difference between the two is the upper frequency limit, which is higher with the 564.

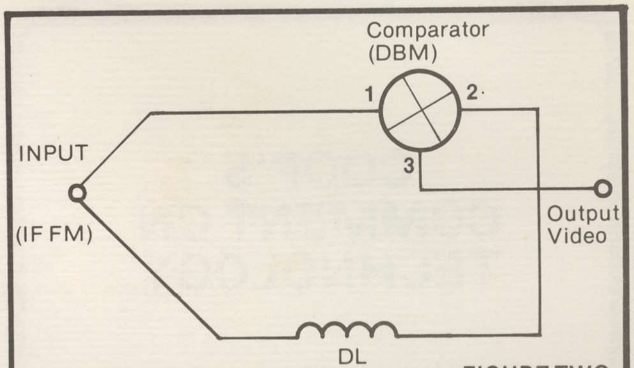


FIGURE TWO

Spisar brings to his PLL experiments a wide and successful background in the design of high quality CATV amplifiers, modulators, demodulators and other devices for several manufacturers of CATV hardware in Canada and elsewhere. As a TVRO experimenter Spisar has developed several different low-cost receiver formats and is currently working on a single downconverter-multiple (two or more) demodulator system wherein separate portions of a house can independently tune-in separate transponders (it was inevitable that the single-receiver-per terminal format for even private use would not linger with us long!).

As Spisar notes ''The principle circuitry blocks included in the PLL chip are the signal comparator and the voltage controlled oscillator. Two signal inputs are required to activate the signal comparator; one of these signals is the 70 MHz FM TV signal fed in to the circuit from the 70 MHz IF amplifier stage preceding the demodulator. The second required signal is supplied by the internal VCO in the PLL. The basic operating frequency of the PLL oscillator is adjustable by placing a small pF variable capacitor across pins 2 and 3 of the NE561 or across pins 12 and 13 of the NE564.''

PRINCIPLE CIRCUITRY BLOCKS IN PLL [NE564]CHIP

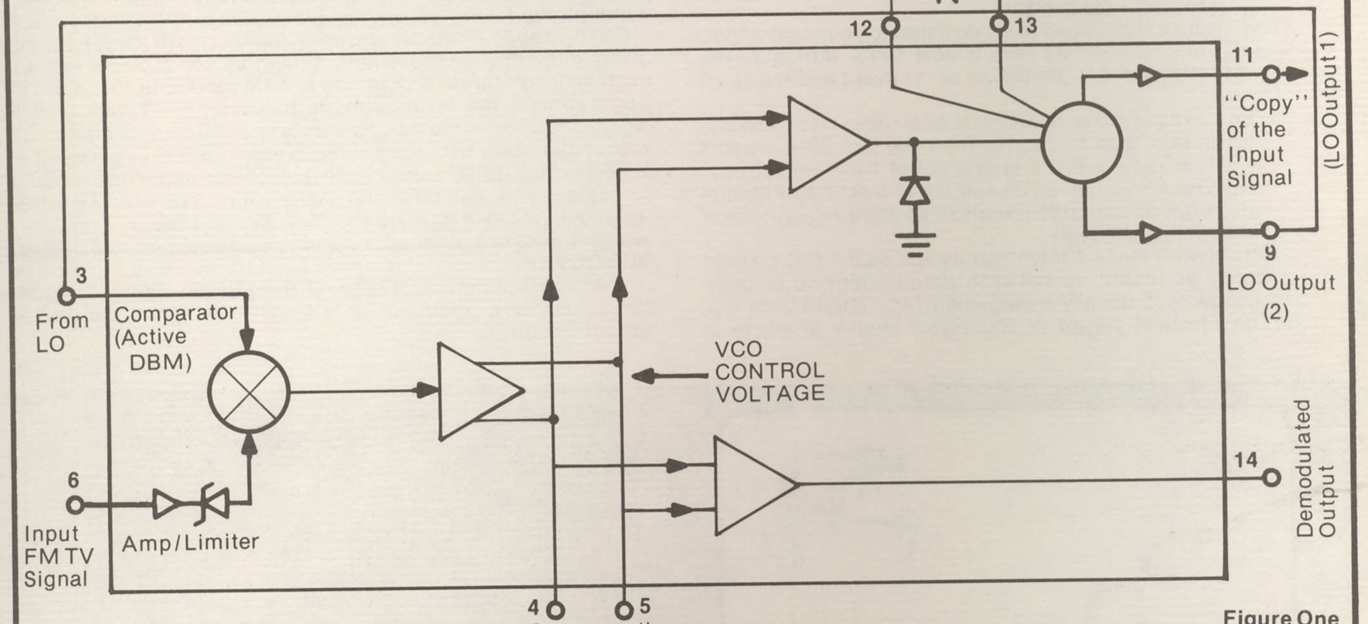
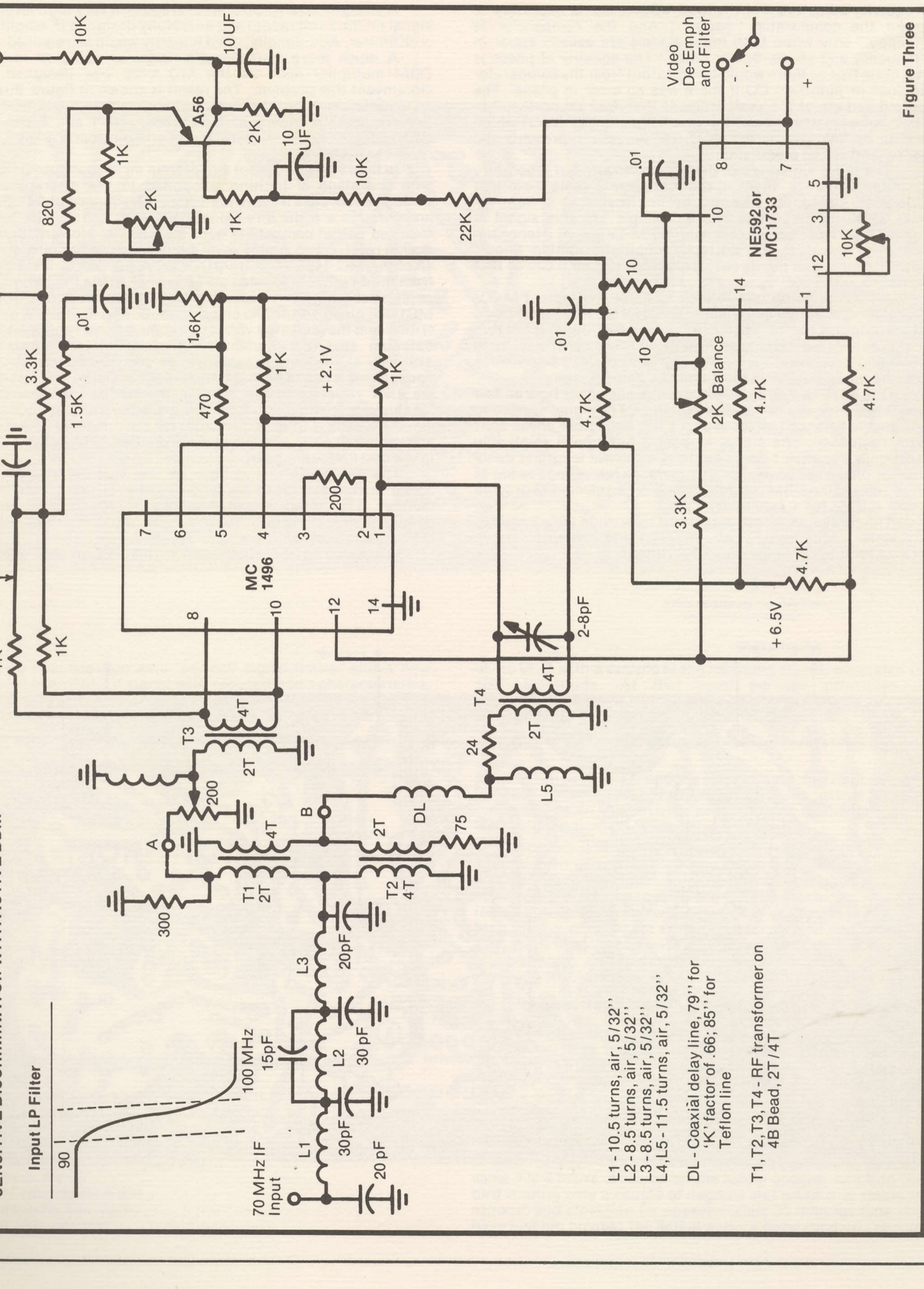


Figure One

The output of the comparator is a voltage (on pins 4 and 5 of the NE564) which expresses the direction and magnitude of

Material Submitted by:
Jan Spisar
Spisar Engineering Ltd.
3732 Baywater Cr.
Mississauga, Ontario



SENSITIVE DISCRIMINATOR WITH ACTIVE DBM

L1 - 10.5 turns, air, 5/32''
L2 - 8.5 turns, air, 5/32''
L3 - 8.5 turns, air, 5/32''
L4, L5 - 11.5 turns, air, 5/32''

DL - Coaxial delay line, 79'' for 'K' factor of .66; 85'' for Teflon line

T1, T2, T3, T4 - RF transformer on 4B Bead, 2T/4T

Figure Three

frequency adjustment of the local VCO which is necessary to make the comparator ''happy''. And the comparator is ''happy'' only when both input signals are exactly equal in frequency and phase. Spisar notes ''The equality of phase is not quite true as there would be no output from the comparator to push or pull the VCO if there was no error in phase. **The output voltage of the comparator is therefore proportional to the frequency deviation of the input signal** (at 70 MHz) **which has to be followed by the VCO and actually represents the video** (and audio) **modulation**''.

The input signal is not **perfect** under any but laboratory conditions; that is, there is **some** noise and **some** distortion present. The signal generated by the local VCO is however very stable in amplitude and a ''sample'' of this signal is almost a perfect ''copy'' of the input FM TV signal. Hence the output of the VCO is a perfectly amplitude limited (input) signal. And as Jan points out ''This is not bad for a device that costs around $3.50!''.

All of the amplitude related noise of the input FM TV signal is gone at this point (some is converted into phase noise at the output of the VCO however). When this signal is fed into a simple discriminator (**see figure two**) Spisar reports he is obtaining improved video S/N (signal to noise) performance than he can achieve with the direct PLL demodulator.

One approach to this technique is shown in **figures two and three**. In figure two Spisar explains ''The signal applied to the double balanced mixer at port 1 has negligible phase shift with frequency. The signal at port 2 has phase related to frequency (for each 1 nanosecond of electrical length of delay line the phase will change by 3.6° and for a full voltage swing at the output of the DBM the delay line will be selected to provide some + / -25° for + / -10 MHz).

The delay line length is selected to provide 25° of shift at the center frequency (typically 70 MHz). For a steeper S-curve delay a line of 270° length could be utilized.

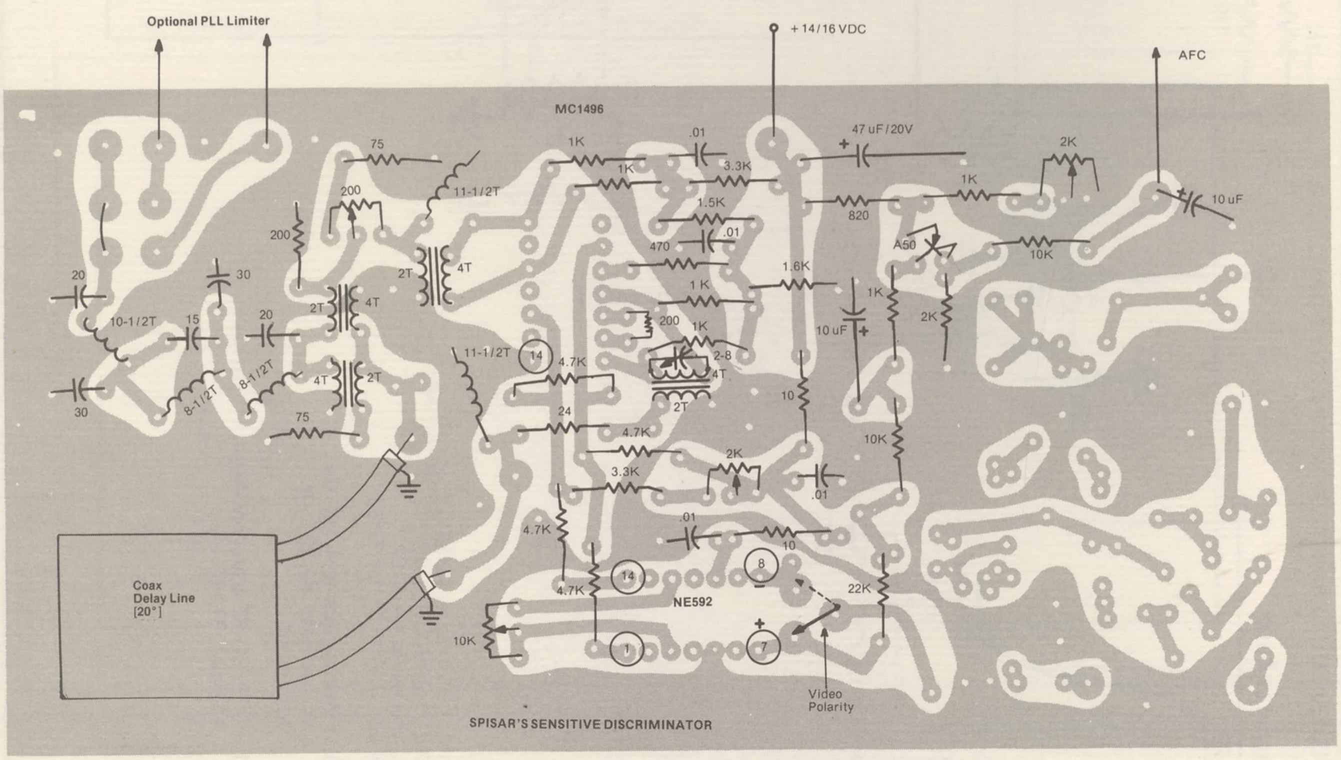
A straight passive DBM would require a very high level IF signal (in the 2 volt range) and a carefully designed IF amplifier with limiter. Additionally, good linearity would be required.

A much more sensitive discriminator using an active DBM/multiplier such as the MC 1496 was designed to circumvent this problem. The result is shown in **figure three**; an experimental (but fine working) approach to this problem. The required frequency shift between pins 1 and 8 can be obtained with either a delay line in one pin (port) or by L/C networks in each port.

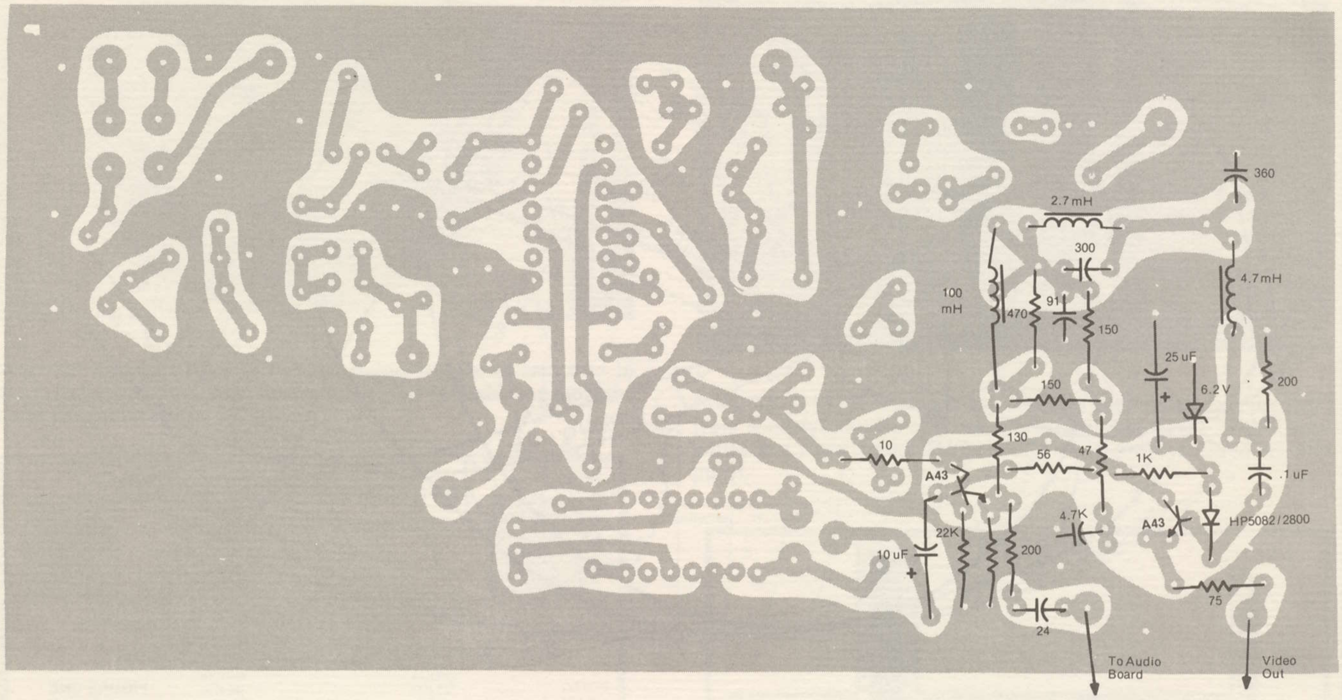
In figure three an input signal from an IF (bandpass) filter with one stage of limiting is applied to the discriminator through a low-pass filter (with a roll off frequency of 90 MHz) and through a 6 dB directional coupler (T1, T2). The level required is that compatible with the popular Howard/Shuch design receivers. A higher level signal is applied to pins 8 and 10 of the MC 1496 via a transformer. A portion of the signal from the directional coupled port B is applied via the delay line or phase shifting L/C network to the ''signal'' terminals of the MC1496; pins 1 and 4. The bias distribution on the 1496 is quite critical and the indicated voltages in figure three represent the optimum bias distribution. The demodulated signal is available at the output terminals (6 and 12) and is strong enough that it has to be attenuated (4.7K resistor) and applied via 4.7K resistors to the input of the NE592. Spisar notes ''Actually more than + / - 0.5 volt is available from the MC1496 and the NE592 is utilized primarily for convenience. The AFC voltage is balanced by a 2K pot in the emitter divider of the A56 (a low cost PNP transistor)''.

The de-emphasis and filter for the video employed by Spisar is very similar to that shown in the Howard Terminal manual. The input signal required to the active DBM demodulator is in the 60 to 100 mV region and the output video is 1V peak to peak. Note the polarity switch.

In conclusion the application of the PLL in this circuit



SPISAR'S SENSITIVE DISCRIMINATOR



VIDEO DE-EMPHASIS AND FILTER
(similar to Howard Terminal)

allows it to function as a 'perfect' signal limiter and a new source of an FM TV signal with reduced noise characteristics. Spisar reports he is now working on additional circuits to separate the noise (or error) signals by combining the sample of the VCO with a sample of the incoming signal, separated by 180° amplitude. At that point perhaps principles of feed-forward correction could be applied to obtain substantial additional noise reduction (i.e. threshold extension).

MORE NOTES ON MOLNIYA RECEPTION

Prepared from data supplied by:
Steve J. Birkill
128 Cross House Road
Grenoside, Sheffield
S30 3RX, England

In the Programming Section for the February issue of **CSD** we discussed the inclined orbit twin apogee's of the Molniya series of Russian satelites transmitting a SECAM color picture centered on 3895 MHz; and the unusual fact that the ''western apogee'' directly above North America is the 'active' apogee for transmission of television programming to Orbita ground receiving terminals in the (northern) USSR.

Recovery of Russian video on this frequency is relatively simple, even with NTSC type receiving equipment; provided you are willing to watch the picture in black and white and have no strong urge to also recover the Russian audio. To graduate from a passive black and white viewer to one that is receiving a high quality color signal without visual picture impairments, and, with the accompanying Russian program audio will require some additions to the baseband portion of your receiving terminal.

The Molniya series of inclined orbit birds have a dual apogee each day; one that 'peaks' roughly over Manitoba and another that peaks 12 hours later over the north central USSR directly north of India. This apogee peak point is shifting westward at a rate of 0.15 degrees daily. There is some slight question as to whether the 'published data' or the 'observed data' is correct and only a series of calibrated observations from some North American viewers will settle that question. Suffice to state that until we know differently the western apogee is **either** around 129 degrees west **or** 99 degrees west as of the first week in April. The usable portion of the apogee, some 3 to 4 hours centered on the actual apogee, will find the bird moving only a couple of degrees and when it is stable in azimuth and elevation for approximately 30 minutes time you have just pin pointed the actual apogee point (and you should

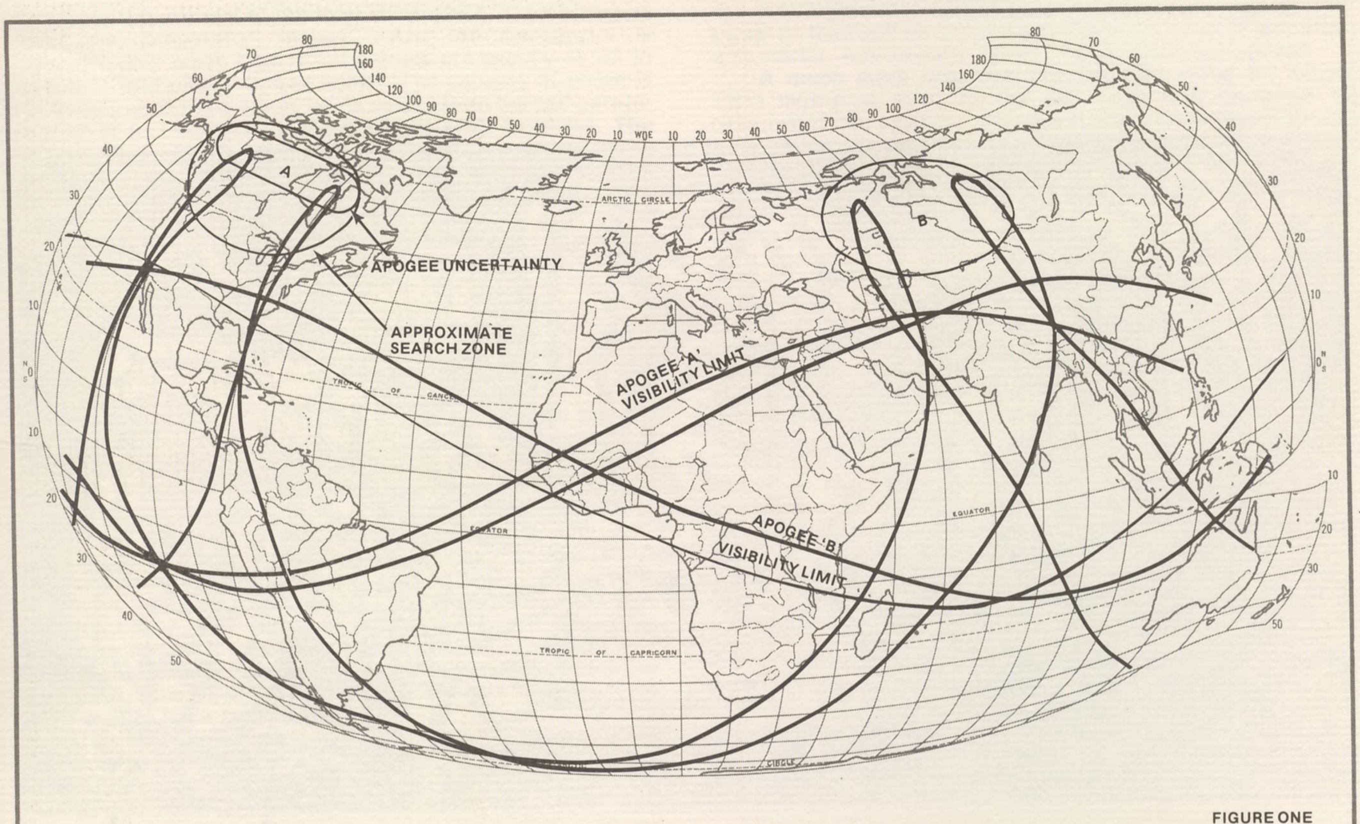


FIGURE ONE

carefully note your apparent heading of elevation and azimuth and report same to **CSD** along with your own coordinates).

Since Molniya series satellites do have a **pair** of apogee periods per day, separated by 180 degrees in longitude and 12 hours time, it might be worthwhile to ponder why the Russians choose to activate these birds with television intended for reception within the USSR when the apogee is over North America versus when the apogee is half way around the world and over Russia. Obviously the choice could go either way, or even both ways. There are several theories on this including:

1) While television transmissions have been observed recently only on the western apogee (A on **figure one**) it may well be that the eastern apogee (B on figure one) has carried television in the past. With a slight westward regression or movement of 0.15 degrees of the apogee per day there is a 'drift' of nearly 55 degrees in a year's time. Molniya birds apparently carry only a single television transponder (centered on 3895 MHz) although audio subcarriers have been noted within the transponder.
2) Since the most useful portion of the orbit (and the portion which is activated for television relay) is the period + /- several hours each side of the apogee, it may well be that during the eastern apogee period the Molniya birds are utilized for a different function; **such as** SCPC or FDM FM communications to Russian ships operating in the Indian Ocean.

Remember that Molniya is actually a **series** of inclined orbit satellites **each following** a nearly identical track around the world; and that as one Molniya moves from west to east through the ascending node (towards apogee) and then through descending node (away from apogee) that there are additional Molniyas following the same track before and after the bird of interest at the moment. This simply means that as a bird moves into the zone of interest (+ /- a couple hours of the apogee) it is activated by ground command and it begins relay of television which it continues to relay until it reaches a point in the descending node where its movement is too rapid to be tracked comfortably by Orbita ground stations receiving the telecasts. At the point the Molniya of interest is switched off and transmission begins via the next Molniya in the chain which is at that point just entering the apogee period of interst. If you are watching a Molniya that 'suddenly ceases transmission' that is your signal to move your receiving antenna back to the point in your northern sky where you first picked up the earlier bird. All of this was covered in considerable detail in the February issue Programming Section.

OTHER CHARACTERISTICS

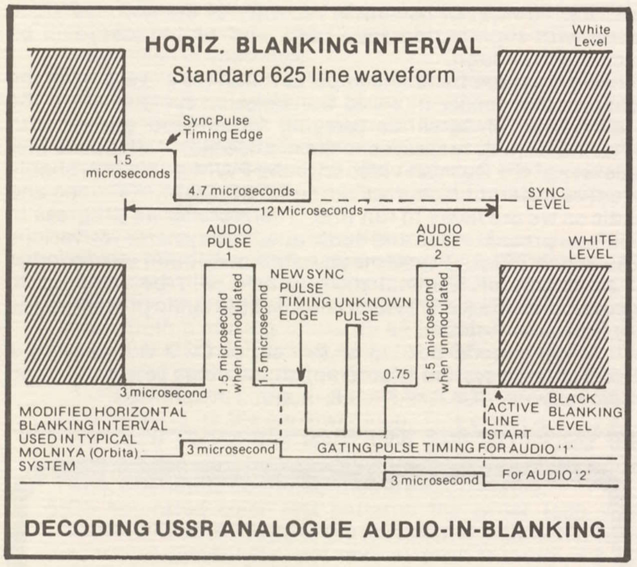
Video transmissions via Molniya can be received in black and white on NTSC (or PAL) format receivers with only minor adjustments to the vertial control adjustments (covered in February). Reception in color will require a SECAM adapted monitor and high quality color will require some additional refinements.

Audio on the Molniya series, unlike the audio on the Raduga/Ghorizont series of geostationary/Clark orbit birds is another matter. Raduga/Ghorizont birds utilize both subcarrier program audio (typically 7.5 MHz) **and** something called **PWM** for pulse-width-modulation (also called sound-in-syncs or sound-in-line-blanking). When subscarriers are found on the Molniya they are in addition to the primary program audio being transmitted with the PWM system.

While it is theoretically possible for Molniya and Raduga/Ghorizont series satellites to be employing virtually any form of polarization they wish, all observations to date by Birkill and others indicate that RHCP (right hand circular polarization) is the only format employed. This suggests utilizing the Birkill Hybrid Mode feed described in the Technical Section of **CSD** for February unless one is willing to 'pay' a 3 dB penalty with a simple linear probe will recover 50% of the wavefront energy present; thus the 3 dB penalty.

To recover high quality video and audio then requires that we design a baseband system that does two separate things not required for reception from North American (or Indonesian) DOMSAT birds:

FIGURE TWO - Effect of flyback being triggered late due to the presence of the PWM audio pulse [see vertical line on right hand side of image].



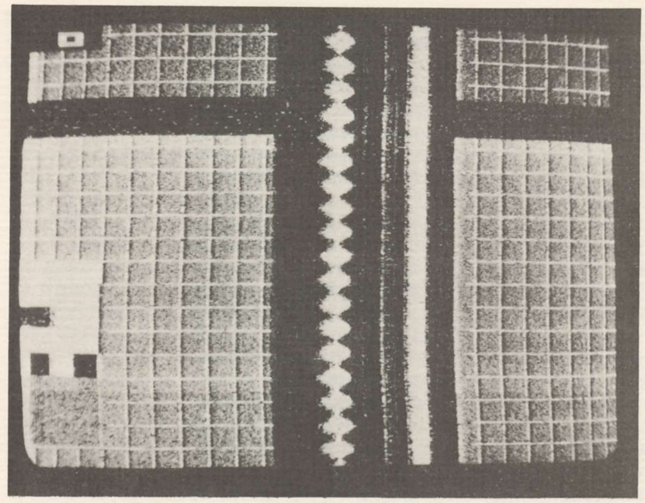
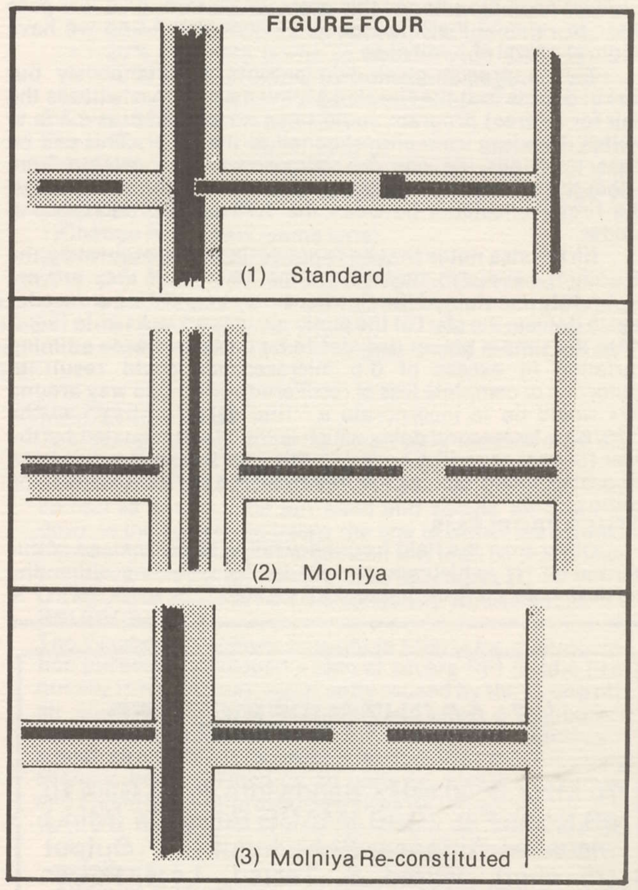


FIGURE THREE- Pulse cross display [electronic test pattern] from Molniya; audio channel 1 is modulated with a 1 kHz tone while the right hand PWM channel is unmodulated at this point.



1) **Recover the PWM audio**, and,
2) **Restore the video** to its original waveform or one that is compatible with our own NTSC type monitors. To restore the video we must blank out the audio pulses and re-insert correctly timed line sync pulses.

Now what happens if we only concern ourselves with recovering the PWM audio and neglect the correction of the video waveform? The PWM audio pulses present produce 'bright-up' on the horizontal retrace and then because the flyback is triggered later than it should be the picture shifts to the left slightly producing a rather bright line down the right hand side of the screen which typically shows the first audio pulse (see **figures two and three**). In figure three the image has been artificially shifted to the left beyond the amount one would normally see with an unmodified NTSC receiver to display the appearance of the twin audio PWM 'channels'. The left hand vertical line is modulated with a 1 kHz tone while the brighter right hand vertical line (second channel) is unmodulated.

BIRKILL'S APPROACH

Birkill's present approach to these twin problems is to substitute entirely new syncs and blanking, locally generated at his receiver site and timed to the incoming signal. These come from a Ferranti single-chip SPG which is a 525/625 line crystal-controlled device. Birkill feels this approach is far too expensive and complex for duplication today however (having been designed several years ago). He suggests a more modern approach would be to generate a new line sync and line blanking pulse using monostable device circuitry triggered by the incoming Russian line sync pulse. **See figure four.** These new pulses would then be imposed on the video in the receiver with an additional processing amplifier.

Comparatively, extracting the audio is easy. There are two (PWM) pulses involved, one each side of the abbreviated (Russian) line sync pulse. Each audio pulse has an amplitude from blanking level to peak white, and an unmodulated width of approximately 1.5 microsecond. The Russians have been observed to be utilizing both 'channels' or pulses for audio and the properly equipped terminal would be prepared to recover either separately (or both simultaneously). Thus the audio pulses must be 'gated out' from the video waveform. Birkill believes the best approach to this is to slice the pulse at mid-amplitude (for best noise immunity) and then to gate it out with a locally generated gating pulse the coincides in time with the audio pulse. The gating pulse should be wide enough to encompass the maximum width or duration of the audio pulse.

The 625 line (Russian) horizontal frequency is 15.625 kHz resulting in a line period of 64 microseconds. From the leading edge of line sync to center of pulse 2 is 3.5 microseconds and to the center of pu se 1 is 61.75 microseconds. If the pulses are capable of being modulated 100% (positively) the peak pulse width will be 3 microseconds. To avoid distortion while retaining a noise margin the gating pulse should be 3.5 microseconds wide. Thus gating pulses for audio pulses 1 and 2 should suggest generating gating pulses by triggering two monostables of 1.75 and 60 microseconds period the outputs of which trigger two more monostables each of which has a 3.5 microsecond period.

The resulting gating pulses are AND-ed (or NAND-ed) with the sliced audio pulses (the gate outputs being just the varying width pulses), recurring at 15.625 kHz but varying in width at an audio rate. At this point we go through a low-pass filter to remove the line frequency component and we have audio at a level of 1 volt or so.

This approach gives two outputs simultaneously but Birkill doubts that the Russian Molniya series ever utilizes the pair for (**stereo**) program audio so an arrangement is made to switch decoding from one 'channel' to the other. This can be done by triggering one 3.5 microsecond monostable from either the 1.75 or the 60 microsecond monostable or switching the first monostable between the 1.75 and 60 microsecond modes.

Birkill also notes that he is not certain how **accurately** the (Russian) waveform timings are maintained. If they are **not** accurately maintained the Russians may be utilizing a decoder which detects the start of the audio pulses and locks onto them. With the simple preset decoder to be described here a timing variation in excess of 0.5 microseconds could result in distortion or complete loss of recovered audio. One way around this would be to incorporate a "fine delay control" on the 1.75/60 microsecond delay which is then field adjusted by the user for best sounding audio. In this way the gating pulse can be easily 'tuned' across the line blanking period to 'find' the audio pulses.

OTHER PROBLEMS

Other than the field frequency being 50 Hz instead of our normal 60 Hz (which you correct for by adjusting either the vertical hold control or vertical oscillator to track for 17% slowdown; readjusting the monitor height control afterwards to eliminate the tall-skinny people!), there is the SECAM color problem. Birkill suggests a normal SECAM color monitor/decoder will probably use the line-rate rather than the once-per-field phase identification system. This is not a color burst (as we know it) but rather an extension backwards of picture chroma into the 'back porch' region. The gating will be from the line sync so it becomes probable that reinserting locally generated syncs will be essential for SECAM color. This can be done by shortening the blanking pulses to pass the color, or as Birkill recommends by inserting a chroma trap in the re-blanking portion of his Russian decoder box.

There is at least one more potential problem. Any true line clamps found in either commercial grade TVRO receivers or in a monitor may clamp on the back porch. If the clamp is timed from the (later) line sync it will act partly on audio pulse number 2 in the Russian PWM system producing audio bars in the video. So where the receiver has back porch clamping the system needs to re-sync and re-blank. It happens that the Howard Terminal receiver widely duplicated is not likely to have this problem since clamping is not done on the back porch in this design.

SUMMARY

CSD recognizes that on the surface "perfect full-color Russian reception" with flawless audio recovering from the PWM pulses may **not** be of interest to more than a handful of readers. **To most of us** simple recovery of the Molniya video (even with slightly degraded black and white video) will be excitement enough.

On the other hand it is important that we all recognize the inherent differences in world transmission systems since the proliferation of satellites carrying video (and audio) with differing formats is assured in the next decade. It happens that recovery of the Russian video with the PWM audio is probably about as different from recovering NTSC DOMSAT video and audio as we are likely to run into. Therefore as we progress in time and present video and audio adaption systems for various PAL and INTELSAT systems you will slowly build a knowledge of what type of terminal modifications will be required to recover all of the (color) video and all of the audio present in the sky from your location.

In our second portion of this series **CSD** will present a Birkill created system to accomplish the video restoration and audio recovery discussed in this month's installment.

WASHBURN RECEIVER UPDATE

ALL PLL's NOT EQUAL?

After my presentation at SPTS '80 Miami (**The Washburn High Performance TVRO Receiver**) I noted a certain reluctance by many in the audience to accept the notion that extreme bandwidth in a PLL detector can indeed produce visible improvement in picture quality at low CNRs (8 dB region). Some with whom I chatted the day after the presentation said they had been assured by other receiver manufacturers that **all** PLL's provide the same degree of (low CNR) improvement.

Upon returning home it occured to me that a well

controlled A-B comparison under identical conditions was in order. Accordingly, the following set up was employed:

1)A Washburn Receiver carefully set up to provide a noise bandwidth of 30 MHz, operated from my antenna previously established to provide 7.4 to 9.1 dB CNRs under almost identical ambient temperature conditions.

2)The demodulator was updated to Errata 3 (**Note:** See separate report in this month's Technical Section) and carefully checked over. R19 and R20 were changed to provide a "K" (-3 dB bandwidth) of 17.1 MHz. A resistor in series with a large tantalum could then be placed in parallel with R20 to restore the normal (26.4 MHz) bandwidth without changing the phase detector balance conditions. Ultimate quieting due to the demod was measured under CCIR weighted and de-emphasized conditions and found to be 69 dB with 26.4 bandwidth and 74 dB with 17.1 MHz bandwidth; assuring that the detector noise floor would not influence the results.

Under actual reception conditions the following was noted:

3)On normal program material sparklies were still predominently white and spot-like, appearing below 8 dB CNR for the wider bandwidth loop. There was a small but definite increase for the narrower bandwidth, requiring on the order of 1/2 to 1 dB greater CNR for the same level of sparklies.

4)Tearing on abrupt transitions from white or saturated colors to lower levels was absent on the wideband loop but noticeable with the narrower bandwidth; to the extent that superimposed letters (such as telephone numbers frequently shown on the religious transponders) produced a tear equal or wider than the vertical number (letter) width itself.

5)Picture granularity (indicative of the **true** threshold where the video SNR drops abruptly) was essentially identical at the **best** adjustment of VCO tuning and DC offset for the narrow loop versus the wider loop; **however**, both picture granularity and flesh tone hue were stable over a very broad range of VCO tuning for the wideband loop versus a very definite "peak" in picture quality and continuous change in flesh tone hue with VCO tuning for the narrower loop. This effect is fully explainable in that the lower loop gain (K) causes the phase detector to operate closer to the limits of its range where dynamic non-linearities are appreciable.

6)On saturated color test patterns the wider loop was essentially at the edge of the sparklies at 9 dB CNR, with sparklies evident (but not severe) down to levels of 8 dB CNR. The narrower loop produced similar sparklie results on the same saturated color bar test pattern when optimally adjusted at CNR levels of 1/2 to 1 dB **higher**.

Clyde Washburn
Fairport, New York 14450

Clyde's new receiver can be expected to receive critical analysis from several quarters including his own competition in the receiver design and production field. Any design that proposes improved performance can be expected to hear indignant cries of "it can't be done..." **from the competition. We note with interest that the latest advertisement from Harris Communications in the CATV trade journals talks of** "...a new development in threshold extension...(**providing**) video static threshold less than 8 dB; typically 7 dB. Subjective threshold performance is even better...". **Engineers create systems; marketing types create words to describe the engineer's system. We'll all have to stay alert to remain up to date in this fast changing field!**

ERRATA #3

Owners of the Washburn High Performance TVRO Manual should take note of the following updates on this receiver system. Some update material here applies to additional corrections to the original manual while other material applies to additional information that has been created by the designer Clyde Washburn.

PLL DEMOD ASSEMBLY - A2A1A1

The following illustration errors have been noted:

1)R2 is incorrectly shown on the **top** side of the PC board (illustration on page 21) from +6V to U1-7. This resistor should be mounted **below** the PC board **from** the unused hole at U1-7 **to** groun d(near ground lead of C10).

2)The components below U5 are not labeled; they are R12 (left) and CR1 (right).

3)C31 is not shown. It should be mounted across the appropriate terminals of R18 **below** the PC board.

4)Z10 is not shown. It should be mounted **below** the PC board from the terminal of R9 adjacent to C30 to the PC board hole at R18 (below Q4). Use sleeving on the leads and orient Z10 to lay over the ground area below U6.

5)Move the schematic connection of +6V to the **right** of Z9 (see page 46).

REGULATOR NOISE

Some otherwise normal 7900 series negative regulator devices have been found to produce large amounts of noise up to approximately 1 MHz unless a large value tantalum output capacitor is used. The following capacitors can be affected:

1)Demod (parts list page 23) - change C19 to 33 uF +/-20%, 10 volts (Sprague 199D336X0016DB1 or Kemet T390D336M010AS);

2)Processing (parts list page 28) - change C27 to 33 uF +/-20%, 10 volts (same as above); change C24 to 33 uF +/-20%, 10 volts (ame as above); change C18 to 33 uF +/-20%, 10 volts (same as above). Add C37 .001 uF +/-10% from U4C to U4E (schematic page 47; part is just left of U5), **below** PC board (same as A2A1A1C1).

SIGNAL STRENGTH METER

The linearity of the signal strength meter may be further enhanced by increasing the processing assembly U6B meter amplifier resistors (page 47 schematic, page 29 parts list) as follows:

1)Change R60 to 24K (same type)

2)Change R61 to 820K (same type)

With this change the output voltage to the meter can be expected to be linear +/- 1/4 dB (typical) from 1 to 19 dB and +/- 1/2 dB from 0-20 dB (typical). If the linear tracking cannot be obtained with these changes, check the meter unit itself.

MISCELLANEOUS

The center tuning meter is incorrectly indicated as 470 ohms on figure 16, page 47; it is 970 ohms nominal.

The jumper shown for the VDT 555 and 600 (page 40) is incorrect as shown. The left hand end should be dropped down to the switch lug **below** the one to which the connection is shown making it the same in this area as that shown for the VDT 400 (that view, rotated 180 degrees).

On figure 18 (page 27) U4 is erroneously labeled as Q4.

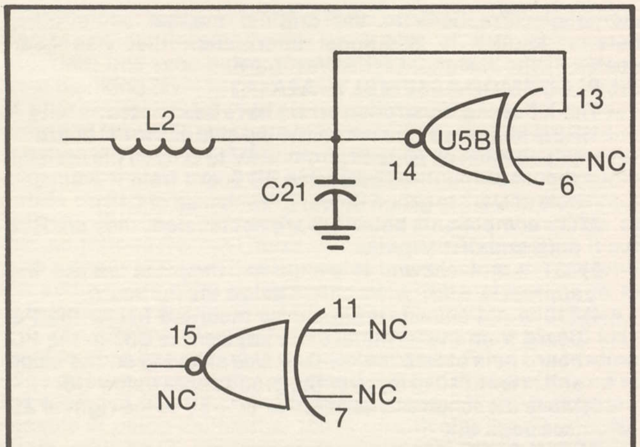
RFI PROBLEMS

The Washburn receiver brought to Miami for demonstration purposes developed a case of severe RFI (Radio Frequency Interference); apparently caused by the strong off-air channel 4 signal in the Miami area (Washburn's Rochester location has no off-air channel 4 of significant signal strength). It is recommended that the following changes be performed on all units as overall uniformity and stability are improved as well as RFI rejection:

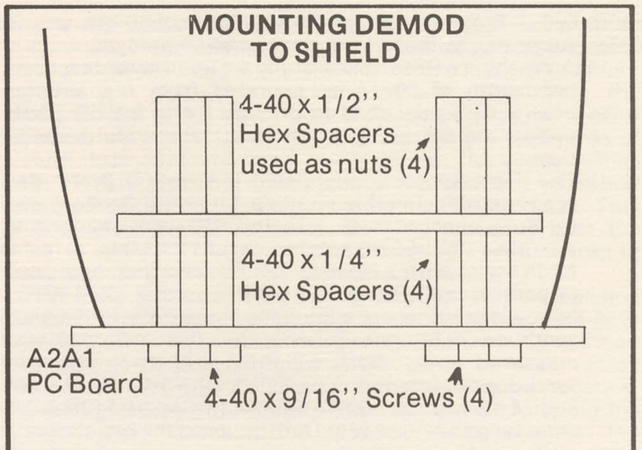
1)**At U1:** (see pages 21 and 46) Delete C9. Add R24 (30 ohm, +/-5%, 1/4 watt, carbon comp) in series with C6 as follows:

a)Mount R24 upright and tight to board in the hole of U1-14. Install one lead of C6 in the ground hold below R24. Place the body of C6 below and parallel to C7 wrapping the second lead of C6 around the top lead of R24 (solder). Note that the 'above' and 'below' refers to the assembly drawing view appearing on page 21.

2)**At U5:** (see pages 21 and 46) Delete CR1, C24, C25, R15, R16 and R17. Cut the trace from U5-14 to U5-11 near the lead of R14. Relocate C21 as follows:



PHASE DETECTOR BIAS GENERATOR MOD



MOUNTING DEMOD TO SHIELD

a) Reference assembly drawing, page 21 - use the lower hole shown for C21 and the upper hole shown for the (unlabeled) standing resistor (pins U5-12 and 13). Bend the lower lead over **below** the board so that it also connects to U5-14. The phase detector bias generator now consists only of U5B tied around itself with no connection to U5C. See schematic here.

b) Change R20 to 150 ohm (same type)

c) Change R19 to 1K (same type).

Additionally, the operation of the PLL demod assembly (A2A1A1; schematic page 46) will be easier to track with the setting of R3 if R4 is changed to 1.2K (same type; film).

Finally, the most convenient method worked out to date to mount the demod to its shield is shown here. Additionally, J1 is best mounted by first putting an extra 3/8 control nut on the jack, then installing it into the shield with just enough protrusion for the lockwasher and nut; then tightening the outside nut. The center pin will now be directly over the hole at C1 (see schematic page 46) minimizing the lead length.

SMALL TERMINAL ANTENNA NOTES

SWAN ANTENNA KIT?

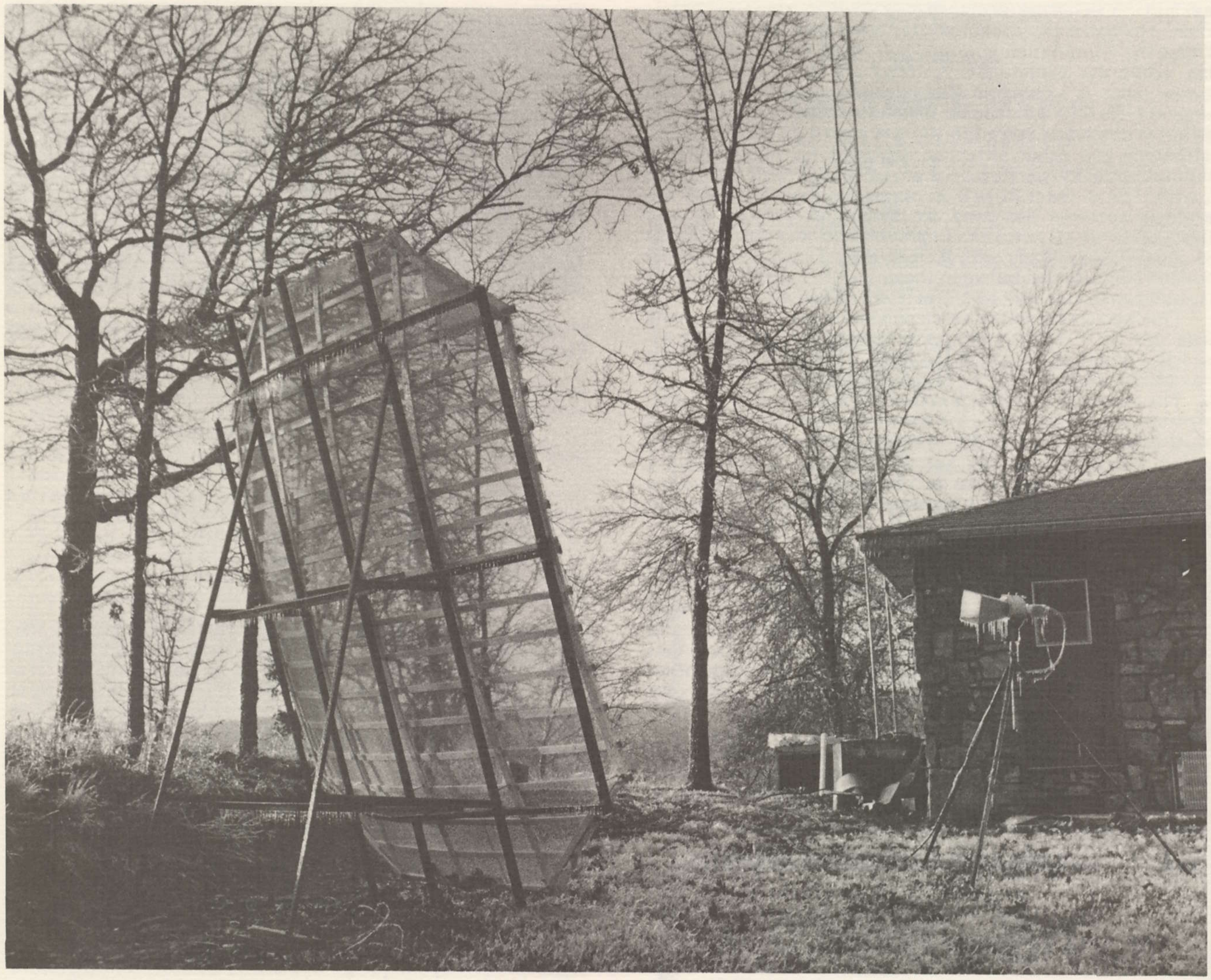
CSD has recieved an abnormally high enough of letters concerning the Swan Spherical TVRO Antenna system described in our STT manual; it seems some users of that manual are having difficulty figuring out exactly how to build the antenna.

The antenna is perhaps so simple to understand and to duplicate that readers are attempting to make more of it than they should. We have been hoping the somebody would come along, in the absence of Oliver, and offer a 'kit' for private home use of the antenna. It appears somebody is about to do so and we hope he has a big mail box!

Hayden D. McCullough (**Vidiark Electronics Development Co., P. O. Box 57, Salem, Arkansas 72574**) first met Oliver Swan during the Oklahoma SPTS event this past summer. From Oliver's description of the antenna and with Oliver's encouragement he set out to build his own. The photos here attest to the construction of the antenna. McCullough notes:

"The geometry is 100 percent Oliver Swan. The mechanical design however is original with me. The frame is 1-1/2'' x 1-1/2'' x 1/8'' angle iron. All pieces are straight. The lattice strips are 1/2'' plywood that is 3'' wide on the vertical

McCULLOUGH'S '8-BALL' ANTENNA - has the geometry of the Swan Spherical but the construction mechanics is pure original. A 16 footer is under construction.



THE '8-BALL' ANTENNA coated with ice after an Arkansas winter freezing rain. Note build-up of slick stuff on the feedhorn and a generous helping of dangling icicles! Antenna kit to be available in 12 foot size is projected to price in the $400 region.

and 1-1/2'' wide on the horizontal. Spacing of the horizontal strips is 8 inches center to center which for this amount of curvature allows the surface to deviate less than 1/20th of an inch between the strips. The antenna pictured is a 12 by 12 foot size and it provides sparklie free pictures using an SCI/150°LNA and an AVCOM receiver. The f to D is 1.25; I suspect there may be another dB or perhaps 2 in there someplace with a more efficient feed horn; mine is 16 inches long with an 8 inch by 8 inch mouth.

This is a very stable, solid antenna and can be adjusted to surface tolerances well within the 1/16'' suggested by Oliver. I have called it the '8 Ball' (get it?) and I am starting on a 16 foot version. The LNA feedhorn is mounted on a piece of 6'' plastic sewer pipe with springy spacers in between. As we are living in 'the early days' of satellite television I go outside to 'turn' my antenna. The rotor comes next.''

McCullough reports that he plans to have the antenna available as an assemble-it-yourself kit around the first of May; perhaps before. The price will be in the $400 vicinity and this will include all of the material cut to fit together, all holes drilled and ready to assemble. The horn/LNA/rotor will also be available on a platform (less the LNA) as an option.

Most people who seem to be having difficulty with the Swan plans are short on elementary geometry. Many skipped over the material appearing on page one of the manual which expresses Oliver's wish that anyone purchasing his manual be encouraged to duplicate his work; but also noting that because Oliver believed he might have certain (valuable) proprietary rights with his antenna that he was purposefully not giving highly detailed plans in the manual. We've heard from many who have followed the manual guidelines through to successful acquisition of the TVRO signals and therefore believe that if you are having trouble with your understanding of the antenna system, that your next stop should be a high school geometry book.

When McCullough has his antenna kit on the market we'll advise you here. In the interim if you can't wait you can write him at the address given.

CHARACTERIZING THE HOWARD HORN FEED

Several builders of the Howard Terminal Manual have expressed an interest in the measured operational parameters for the feedhorn included in the Howard Manual. Jack Trollman of Equatorial Communications recently completed a series of tests on this feedhorn (see photo illustrations) at the request of Tay Howard. These tests indicate (much to Tay Howard's relief) that the Howard Terminal feedhorn is indeed a very suitable antenna for the uses described in the manual.

The horn was designed to be a compromise between high

gain and low noise performance over a two to one range of f/D ratios. The generally accepted maximum gain compromise is to have the illumination energy down 10 dB at the edge of the dish, while the minimum side lobes are to be down 20 dB (lowest noise is related to the side lobe performance). The range of f/Ds found in most of the antennas either now on the market or described in the literature is from 0.25 to 0.55. Radio Astronomy and other antennas designed for low noise and minimum sidelobe performance are generally fairly deep; that is, with f/Ds in the 0.25 to 0.30 range. On the other hand the parabolic surfaces designed for maximum gain (with less atttention to lowest noise and improved side lobe performance) are usually fairly 'flat'; with f/Ds in the 0.5 region. The most common compromise between these conflicting requirements is to build antennas with an f/D of from 0.4 to 0.45.

The feed compromise which should be made with a prime focus horn for TVRO use should be toward the low side lobe / low noise illumination end of the scale. That says being 15 dB or so down at the edges of the parabolic surface.

The Howard Terminal Manual feedhorn measurements, courtesy of Jack Trollman, are shown here in **Table One**. The actual E and H plane patterns measured by Trollman were plotted and added to this set of numbers was the space attenuation to the edge of the dish for each f/D. Table One is a set of averages for the E/H planes plus the space attenuation losses.

The conclusion to be drawn from Table One is that the Howard Manual feedhorn is a reasonable compromise for f/Ds between 0.3 and 0.5 for TVRO use. The gain and noise differences balance in such a way that carrier to noise ratio (C/N) performance will vary only a fraction of a dB over that range of focal ratios. Stated another way, the effort spent on designing and building a customized horn for a particular reflector f/D will probably buy very little in performance; generally under 1 dB additional gain in the very best case.

Finally, as Tay Howard notes "While there is no magic left in the reflector antenna game, we shall probably hear magical sounding claims in the next year or two as people or firms new to the business and measurement of gain (C/N) learn what it is all about. There is still some good engineering to be done...particularly in the area of new materials and manufacturing techniques which will ultimately produce dual reflector antennas having C/N performance perhaps from 1 to as much as 2 dB better than what we have now come to accept as standard. I feel these will not be prime focus, 55% efficiency antennas, but rather dual reflector on axis and offset fed configurations with aperture efficiencies approaching 80%."

HOWARD TERMINAL HORN design as in use at the Howard Terminal in California.

TABLE ONE

f/D	**Edge Illumination**
0.5	**-11.4 dB**
0.45	-12.4 dB
0.40	**-14.4 dB**
0.35	-16.4 dB
0.30	**-18.6 dB**
0.25	-23.0 dB

THE WORLD ABOVE 10 GHz

by
Robert M. Richardson
Richcraft Engineering Ltd.
Drawer 1065
Chautauqua, N.Y. 14722
[716]753-2654

SUMMARY

Last month's episode described how very easy it is to build a crystal-controlled weak signal source for either the 4 GHz TV satellite band or 10 GHz amateur band using a VHF Engineering TX-432 1 watt kit transmitter as the crystal-controlled rf power source. This month we will describe a relatively simple procedure you may use to determine the azimuth of your big TV satellite parabolic reflector antenna to within approximately 2/10th of one degree accuracy **if** you can tilt it over so as to receive a signal from last month's crystal-controlled weak signal source. IF you cannot tilt your antenna over to the horizontal plane, skip our column this month.

ANTENNA ALIGNMENT FUNDAMENTALS

Over 100 of you Satellite Digest readers have availed yourselves of our FREE (for $5) service that gives you a computer printout of the azimuth and range from your home location to all the Comstars, Westars, Satcoms, Aniks, and Statsionar birds in the western hemisphere. Counting computer time, secretary time, postage and handling it costs us about $7.50 per printout, so this month onwards the price is hiked to the munificent sum of $7.50 each. End of commercial.

Now that you know where you wish to point the big bazoo you have the problem of **how to point it**. That is what this month's column is all about. A better title for this month's column would be: **"ELEMENTARY SURVEYING 101 - USING THE NORTH STAR."** We will not insult your intelligence by going into the Cub Scout routine of telling you how to find the North star, Polaris, on a clear night. If you cannot find the big dipper, you have a problem. Go directly to the nearest Cub Scout, do not pass GO, do not collect $200. Ask the Cub Scout to show you how. By one means or another, we shall presume you know how to locate the North Star.

THE METHOD WE PLAN TO USE

1) We are going to build a "sort of" homebrew transit from a camera tripod, a $5.00 B-B gun telescopic sight, and a 49 cent piece of dime store steel measuring tape.

2) We are going to "shoot" Polaris on a clear night and place a stake in the ground which is "true North" from measuring site.

3) On a clear sunny day we are going to rotate our telescopic sight on its level tripod mounted platform till the marks from the steel rule which reads out 1 degree for every 1/8th inch mark tells us we are on the azimuth to the bird we wish to locate. We will put the stake in the ground for each bird's azimuth...and hopefully mark it.

4) We will spot our crystal-controlled weak signal source over the stake representing the azimuth to a given bird (hopefully at least 100 feet away from our dish), and rotate our big dish for maximum received signal on 4 GHz. The dish should now be pointed exactly at the correct azimuth for this particular bird. All we need to do now is to tilt the dish to the bird's correct elevation angle, and if we did everything right, there it is. Like most good things in life, it is actually much easier to do than describe.

BUILDING THE HOMEBREW TRANSIT

If you already have a fairly sturdy camera tripod, you're already half-way done. Otherwise, we suggest the Sears-Roebuck #3HA8465 tripod which is in the $40 price class.

A) Purchase a cheap steel tape measure **insert replacement**.

B) Using a jig saw or sabre saw, carefully cut out a disk of exactly 14-11/32'' diameter from 3/8'' exterior plywood.

C) Drill the exact center of this plywood disk 1/4'' D.

D) Insert a 1½'' long by ¼'' diameter bolt **with** 1/4'' body or fender washers on each side through center hole and tighten snugly.

E) Mount bolt with disk on it in a drill press or heavy duty electric drill.

F) With a piece of sandpaper on a sanding block lightly sand down the circumference of the plywood till it equals exactly 45 inches, no more, no less. Measure circumference frequently so you do not over do it.

G) Glue a sheet of heavy white bond paper to one side of the plywood disc with rubber cement, trimming edges cleanly with sharp scissors or razor blade.

H) Cut off tape measure at exactly 45 inches. Now, using scotch tape temporarily mount the tape on the circumference of the plywood disk with **measuring** side of the tape on the **inside**. Allow about 1/8'' of the tape **over** the edge of the disk so you can readily see the 1/8'' markings.

I) Using a sharp pencil, mark every 1/8'' around total outer edge; i.e., 8x45 = 360, hence every 1/8'' mark = 1 degree.

J) Draw a pencil line with a ruler from the center out to every 10 degree mark and number appropriately.

K) Using a 15/32'' D drill bit, re-drill center of plywood disk. Press fit and epoxy and 1/4-20 nut into center.

L) All U. S. standard camera tripods have 1/4-20 bolts mounted in the center. Using a center punch first, carefully drill a 1/16'' deep hole in the center of this bolt with a #60 drill.

M) Using either plywood or balsa wood, make a ''U'' shaped cradle approximately 10'' long to snugly hold the cheapy B-B gun or .22 telescopic sight. Epoxy the pointed end of a small finishing nail in the **exact** center of this mount so the point protrudes about 5/16'' from the bottom as it will center itself in the hole drilled in ''L'' above.

N) Using stiff piano wire about 1'' to 2'' long, epoxy these pointers in the center of the front and rear segments of the ''U'' shaped cradle. Adjust length so that pointers exactly reach the outer disk degree marks. With cradle centered and one pointer on zero degrees, the other should be **exactly** on 180 degrees if aligned properly.

O) Make a plum bob from a heavy nail and hang with string from the bottom center of the tripod.

STAKING TRUE NORTH WITH W4UCH TRANSIT

Is simplesville personified **if** you can see the North Star from your big dish's site. If do not have a clear shot at the North Star, buy a Nautical Almanac/Ephemeris, study 15th century navigation, and use another star, planet, or the moon. Let us presume you do indeed have a clear shot at the North Star and proceed from there rather than getting all wrapped up in the fundamentals of reverse navigation; i.e. ''you KNOW where you are, all you are trying find is an **exact** true heading reference, hopefully to within .2 degrees accuracy.'' The other alternative is to use a compass, correct for local magnetic variation, ''east is least and west is best,'' and issue a silent prayer as this method **may** or may not give you the accuracy you need **unless** you have an **accurate** bench mark.

This method starts off much like gypsy chicken-pot pie, the recipe states: ''first you steal a chicken,'' but instead of a chicken, ''first you borrow or steal a carpenter's level,'' if you do not have one. Set your tripod up over the center of your big dish's mounting point. Tightly screw the tripod's 1/4-20 mounting bolt into the plywood disk's mounting nut. Using the carpenter's level, level up the plywood disk in both axis with the zero degree mark pointing due North. How do we know it is pointing due North? Courtesy of the North Star of course and our cheapy telescopic sight sitting on the plywood disk. If the disk is leveled correctly, you should be able to change the elevation up and down with the level lying crossways on the disk showing **level** for any angle of elevation.

Our scope sight merely sits on top of the plywood disk and is held in place solely by the small nail that rests in the drilled out center of the tripod mounting bolt. It may be lifted off the plywood disk and the level placed on the disk cross-ways to

check alignment as often as you wish. Once you are satisfied you have the disk exactly on true North, leave the tripod in place and go to bed till the sun comes up.

Now comes the fun part of the program. The sun is out and shining brightly. With your plywood table aligned exactly on true North we merely rotate the scope on the **level** table to whatever azimuth our first TV satellite is located at and drive a stake in the ground around 100 feet away. Continue placing stakes for the other satellites whose azimuth you wish to mark. That's all there is to it.

FINAL AZIMUTH ALIGNMENT FOR THE BIG DISH

You have surely read in the literature all the advantages and wonderful things that **Polar** dish mounts afford the user. Sad to say, most polar mounts will **not** work with this method of alignment. Here is where the AZ-EL dish mount really shines as it works perfectly with this simple system of alignment. As the venerable madam said, "you pays your money and takes your choice."

Place the crystal-controlled weak signal source over the stake you drove into the ground for a given bird around 100 feet or more away from your big TV satellite dish. With the big dish aimed at the weak signal source "swish it about a bit in azimuth" until your satellite receiver's "S" meter indicates you have it on dead center and mark your AZ-EL mount accordingly. **Beware** of multipath reflected signals. If your satellite receiver's "S" meter shows maximum when the big dish is aimed 10 ot 15 degrees **away** from the weak signal source, what you are picking up is a multipath reflected signal. It is just like VHF/UHF instrument landing systems multipath effect. Do not fly your aircraft into a mountain ridge or land it on a rice paddy just because the localizer and glide path needles are centered on the multipath signal. Similarly, make doggone sure you have the **direct** signal from the weak signal source before you mark your polar mount for this bird.

FINAL ELEVATION ALIGNMENT FOR YOUR BIG DISH

A 9 to 12 inch diameter plastic protractor, either draftsmans' or homebrew type located at the elevation axis of the big dish mount will give you a good starting point for elevation alignment. Just as before, "swish it around a bit," for maximum signal. That's all there is to it.

RICHCRAFT ENGINEERING LTD.

...offers you a computer generated printout for antenna azimuth and elevation pointing from your receiving site to all major geostationary satellites capable of being received in North America. This provides you with a basis for locating the following satellites: SATCOM F1, F2, and, WESTAR I, II and III, and, COMSTAR I, II and III, and, ANIK III and B, and, Ghorizont, and, STATSIONAR 4. Provide them with your geographic coordinates (longitude and latitude to within 10 minutes, taken from Road Atlas if no other source is available) plus $7.50 to handle shipping and handling and write to Richcraft Engineering Ltd., Drawer 1065, Chautauqua, New York 14722 (716-753-2654).

TECHNICAL CORRESPONDENCE AND NOTES

IMAGE NOISE?

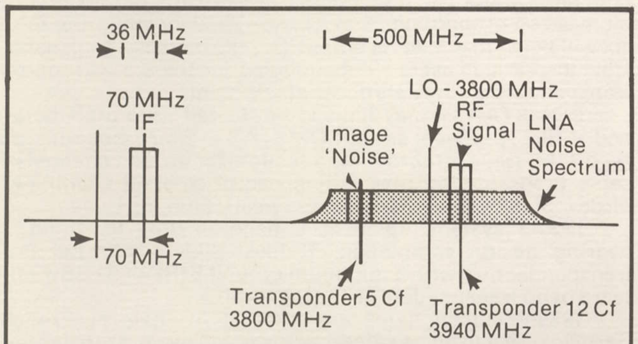
I don't understand how the Coleman (or any other) single conversion down converter, with or without an active mixer, can yield an optimum noise figure. After all, the image frequency is only 140 MHz below (or above) the desired RF signal and certainly within the bandwidth of the LNA. Even if it is argued that there is no RF transmission at the image frequency because it falls in between transponders the LNA will still put out noise at the image frequency. Thus, the noise at the output of the LNA, at both the RF signal frequency and the image frequency, will appear at the 70 MHz IF. With Howard's double conversion system the image frequency is over 2 GHz from the RF signal frequency so it is probably beyond the bandwidth of the LNA and the mixer. Thus the

single conversion system would appear to see twice as much noise from the LNA than the double conversion system. The single conversion technique results in doubling the noise temperature of the system.

If my reasoning is incorect I would appreciate an explanation of where I went wrong. If I am right I will then attempt to build an image rejection mixer for my single conversion down converter.

Norman R. Scheinberg
Jet Propulsion Laboratory
Pasadena, CA 91103

Your reasoning is sound enough. There is a performance/ system cost trade off going on here when a builder opts to single convert rather than double convert in arriving at the final (usually 70 MHz) **IF. The 70 MHz IF places your image as shown here; if the LO is on the low side of the incoming RF signal** (it is also possible to have the LO above the incoming frequency in which case the image frequency is above). **Image frequency bandwidth can contain pure noise, another modulated transponder channel or some combination of the two. As an example, if your desired transponder is number 12** (3940 MHz) **your LO on the low side would be 3940 -70 or 3870 MHz. The image would be 3870 -70 again or 3800. It turns out that 3800 is the center frequency for transponder 5;** a vertical transponder. **Transponder 12 [our desired channel in our example] is a** horizontal **channel. Thus the image falls** (always) **on a transponder of the** opposite **polarity [or outside of the band entirely]. This suggests since we expect to have between 22 and 27 dB of cross-polarization rejection as a minimum on SATCOM and COMSTAR birds that we won't see the actual RF signal from the image frequency** (as long as our cross pole rejection of our antenna is good).



THE SINGLE CONVERSION IMAGE PROBLEM

But there is noise there and that noise does hit the mixer. Whether it degrades the system noise temperature by 3 dB (double the noise voltage) **is arguable. Whether it degrades it to some measurable amount is not arguable. Single conversion receivers cost less to build but at some [measurable] penalty in performance. A handful of the commercial receivers on the professional market single convert to 70 MHz but they do so with the addition of an [expensive] 3.7 to 4.2 GHz 'tracking filter'. This filter tracks through the 4 GHz downlink frequency span as the radio is [voltage] tuned and place a typically ±/-25 MHz wide bandpass filter between the LNA output [receiver input] and the downconversion mixer. By doing this they reject the 140 MHz removed image component. Tracking filters have remained expensive at 4 GHz [and on occasion erratic in operation] but in some design minds** it is **less expensive to install a tracking filter at the input** than **it is to design a double conversion system.**

If one presupposes that tracking filters could be built cheaply in mass production, and their erratic behavior [at 4 GHz] tamed, then this opens up a designing challenge for some inventive soul. We suggest that a well designed tracking filter, capable of being mass produced at low cost, would earn for its inventor big bucks because with such a device readily available virtually all of the sound arguments for double conversion disappear. Double conversion remains the pure way to go today **but only because of this problem.** Anyone feel the challenge?

VTR DEGRADATION

In reading your part 4 of the excellent series appearing in Radio Electronics, I wanted to comment on a rather obscure technical point. You advise possible use of the home VTR for modulation (via the built-in modulator in the VTR) of the video signal received from the satellite receiver. Some early VTRs did in fact allow loop-through video. However, to the best of my knowledge, all current VTRs (whether U-Matic, Beta or VHS) do not have loop through video but rather E-E video. This means that the video signal has the luminance and the chroma split, the chroma downconverted to 688 kHz, and otherwise processed as if for recording...and then converted back up to NTSC as a video signal. This is useful to assure that your (record) electronics is functioning properly. Unfortunately this also results in a significant loss of video quality...compared with the quality that one would expect of a video signal that does not undergo this unnecessary (for TVRO modulating) E-E processing. Of course such degradation of the video signal works to cross purposes with the excellent quality one would expect from a satellite TV signal.

Carlton Sarver
New York, NY 10024

We've heard that suggestion previously and agree that if you run identical satellite video feeds into side by side 'modulator' where one consists of a VTR and the other consists of a designed-for-CATV modulator you can see with the eye detectable degradation of the VTR (re) **modulated signal. Is there a reader out there who is well versed on this subtlty of VTR design who could provide both a straight forward explanation of what happens to the video signal as it 'loops into' and through a typical VTR, as well as a discussion on how bad a choice you might be making by utilizing a handy-dandy VTR as a modulator for home TVRO reception? We'd all like to know more about this, and a solution if there is one!**

STARTING YOUNG

I am a junior in high school and currently attempting to build one of the most inexpensive earth stations ever built as a project for the Westinghouse Science Search; a top notch scholarship project. Through trial and error I have been able to come up with a block diagram which I believe will work.

My project began when I saw Bob Cooper on the **CBS Evening News** in October of 1978 describing his own private satellite terminal. And I am now plugging into the right sources and coming up with some information. I am very interested in microwave technology and **will** make a career out of it. I read Coop's series on microwave Gunnplexers in **Popular Electronics** (October and November 1978, January 1979). My hat is off to Coop for creating these projects and publishing them!

I fully expect that because of appearing on newscasts and the like you have been swamped with requests for help. However I would really appreciate your looking at my block diagram and suggesting how it might be improved.

Brian Crawford
P. O. Box 1034
Wasilla, Alaska 99687

Brian's diagram, which he thought out for himself, shows a 120 degree K LNA driving a mixer which is also driven by an LO operating in the 3630 to 4130 range. He demodulates at 70 MHz and feeds into a low power TV modulator and into his TV set. That is of course Robert Coleman's approach almost to the crossing of the T. We remember our **junior year in high school** (barely) **and how we entered a national science fair project with a demonstration of long range television reception. With such fond remembrances of our own youth** (yes, we won the science fair contest for the state of New York) **we shipped Brian a set of manuals from STT as a gift. We expect he is now up to his eyes in scrouging microwave parts.** Help a youngster stay off the streets of Wasilla. **Like any 15 year old he's scrounging for microwave parts.** Send him some!

WANTS IT CHEAP

We have become quite interested in satellite TV reception and the recent series of articles in RADIO ELECTRONICS has been most helpful. Since the FCC recently removed the licensing requirement, we feel that the interest and market is bound to escalate very rapidly.

Unfortunately being a lowly state electronics technician my budget cannot tolerate the likes of Collins, Hughes, Microdyne and other commercial video receivers and LNAs. Being a typical Ham I have been searching for surplus and economical equipment sources which can be converted to satellite reception. I have access to a dish about six foot in diameter which has been in service in the 960 MHz STL band. Can it be made to work?

Deane Harper
Conway, Ar. 72032

Several people have six foot systems up and running in the midwest and the pictures, while not perfect, are quite good. As most are aware, we did extensive tests on a six foot terrestrial microwave antenna (see front cover of Satellite TV Handboodk for photo) **and found that with a 120 degree LNA you could enjoy the pictures in a 35 or 36 dBw footprint region although they wouldn't earn you any awards. One chap told us he has taken a six foot and 'expanded it' to an eight foot and that got him around 1.5 dB more signal. The bottom line is that a six foot will produce watchable pictures, with sparklies and some audio noise, with either surplus converted gear** (as per our Coleman TD-2 Conversion Manual) **or with start-from-scratch gear such as the Howard Terminal receiver. Once you get it up and running, then you can worry about making the antenna bigger. Was the first car you bought the last car you bought? Sometimes it is more important to be moving down the street than to spend too long waiting for the exact model, color and equipment you'd ideally like to have!**

LNA BOARDS AND HELP

Simcomm Labs (Box 60, Kersey, Co. 80644/(303)352-1020) is a relatively new source of microwave hardware circuit boards and sytems that will help you get your own homebrew TVRO up and running. Simcomm has the following circuit boards available:

1)**LO-1A** - a 2300 MHz local oscillator board with a crystal controlled source and 18 X multiplication; Output level is 0 dBm ($32.50);

2)**RF-1A** - an RF amplifier capable of delivering 2 watts output at 2,300 MHz utilizing four NEC transistors (not supplied), $22.50;

3)**SL-2B** - 2,300 MHz receiving converter with 2 stages of RF gain, remotely tuned LO with AFC provisions, three stages of IF gain (any IF from 30 to 300 MHz), conversion gain typically 45 dB, $22.50;

4)**IF-1A** - a 70 MHz IF amplifier with 115 dB of gain on four PC boards and a pre-amplifier board; typical bandwidth 25 MHz, with built-in baseband output and FM discriminator, AFC output (with amplifier), ($125.00).

Of particular interest to the TVRO enthusiast is an LNA board utilizing three stages of NEC GaAs-FET providing 38 dB of gain with a 1.2 dB noise figure. The **LNA-2B** board sells for $55 and comes with documentation for construction of the LNA (**note:** NEC devices presently recommended are the NE244 [2 stages] and NE 218 [one stage]).

TECHNICAL NEWS NOTES

RCA now plans to launch the SATCOM FIII replacement and have it operational by October of 1981 while the SATCOM FIV bird will be operational by February 1982. RCA is hoping to upgrade the FIII replacement and FIV birds from the nominal 5 watts per transponder to 5.5 watts output (0.3 dB increase on ground) on 18 of 24 transponders while the other six will boost to 8.5 watts output (2.1 dB increase on ground). How the various users will be juggled for the 8.5 watt output transponders is anyone's guess at this point.

COMSTAR IV may have to be 'forced' into orbit before end of 1980; probable use of COMSTAR D-2 bird (see separate report this issue, programming section) for up to 11 channels of cable programming plus failing health of other COMSTAR birds (noteably D-1 at 128 degrees west) is forcing issue.

INSAT system, domestic C band satellite for India, is nearing design completion. It looks like it will be a 12 transponder bird with a minimum ground EIRP of 32 dBw plus two S band transponders at 42 dBw level.

1983-4 launch dates are forecast for pair of French-German direct to home satellites. Birds will locate at 19 degrees west, with coverage areas of 2.5 degrees longitude 0.98 degrees latitude for the French operation, 1.62 degrees longitude and 0.72 degrees latitude for the German portion. A total of 5 TV channels will be on both birds with the French utilizing right hand circular and the Germans left hand circular. Output powers in the 11/12 GHz bands will be on the order of 200-260 watts per channel.

NASA is proposing to launch a pair of 20 GHz downlink (30 GHz uplink) satellites to test spot beam concept over US. One bird would divide US into 25 areas with a spot beam dedicated to each; the second would provide ten high density spot beams to major metropolitan areas (only). ATT's latest proposal calls for spot beams that 'scan' across nation in fraction of a second.

Serious blow to Japanese domestic satellite/rocket program occurred as experimental ECS-B Ka band (32/35 GHz) satellite disappeared during (you guessed it...) apogee kick motor firing. Satellite was launched February 22 from Japanese Tanegashima test range, and 8 seconds after apogee motor firing it discontinued radio telemetry signals. SATCOM FIII had similar problem 15 seconds after apogee motor firing last December. In all five different satellites (including original SYNCOM I) have been lost during this apparently critical manuever.

Soviet Raduga series bird Statsionar-2 was launched in February and should be operational at 35 degrees east by time you read this. Soviets reported launched total of 12 satellite payloads during February.

COOP'S COMMENT ON PROGRAMMING

AFTERMATH OF SPTS MIAMI

Last month's **CSD** reported on the apparent good fortune of those suppliers who were able to sign up early enough to get exhibit booth space at SPTS '80/Miami. We reported in excess of $2.5 million in orders to come from show contracts. An industry trade newsletter (**Satellite News** in their February 20 edition) noted ''Major earth terminal equipment makers were '**probably flabbergasted** ' at the amount of business...at SPTS Miami''. The majors in this case means the Scientific Atlantas, the Microdynes, the Microwave Associates and so on. If they were flabbergasted (all had at least one representative present and roaming the floors) their sentiment was equally shared by the 'minor earth terminal suppliers' in attendance.

The fact is SPTS Miami was possibly too successful. Too many people bought too much equipment and too few suppliers are available to fill the overflowing order baskets. A few stories (true) will suffice to illustrate the dilemma these pioneering manufacturers face.

> **One antenna supplier** walked into the show having sold a dozen antennas prior to the event. He walked out with orders for more than 200 and that number again promised.
> **One receiver manufacturer** with a prior to SPTS production run of 25 units left the show with orders for more than 250 units; and an additional 600 or so promised.

People representing themselves or firms that wanted to be in the re-sale (i.e. installed terminal) business were perplexed by the long lead times. A Nebraska correspondent writes ''I have kept in contact with some of the (hopeful) distributors who attended in Miami and we have all come to the same conclusion...that is, there are very few companies that can deliver product in a reasonable period of time. Many were 'promised' off-the-shelf delivery at the show. That turned out to be 30-60 days by the end of the seminar and now we are finding that it will be 90-120 days for actual orders''.

Another would-be distributor writes ''I have designed a marketing plan that is modest to begin with; in a two state area I feel confident I can sell 100 installed terminals per year. However, getting the first one delivered to me seems to be a big problem!''

Yet another distributor-to-be voices concern that the flame of this new industry may blow out early-on simply because the demand is so greatly exceeding the available supply. ''With the next seminar coming up in July and the addition of perhaps hundreds of new, additional would-be distributors, won't this cause even greater delays for us???'' asks another concerned investor.

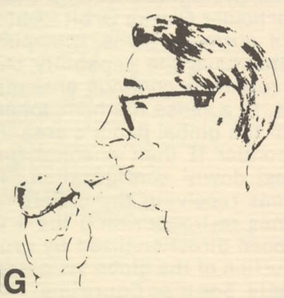
Let's survey what is practical. The 'major' antenna/receiver/LNA producers have been recently surveyed by their trade press and the feeling is that bunch of suppliers can provide perhaps 200 brand new terminals per month. This 200 new terminals will go to the cable industy (both first-time terminals and now that Cable Net II seems alive, second terminals for many), to motels and hotels installing terminals, educational institutions, broadcasters and so on. At the 200 per month rate there won't be much of a surplus around for our 'private' industry even if our 'private industry buyers' are somehow willing and able to pay the big ticket prices that go with the commercial gear. Let's be fair however - let's assume optimistically that 20% of the major's 200 terminal per month production capability could be purchased in the 'private' market. That's 40 terminals per month.

Now let's look closer to home. If one fairly assumes 750 complete terminals were ordered at SPTS Miami, that translates to a 120 day delivery span of 4 months or 187.5 terminals per month. If we deduct the optimistic 40 per month which **we suggest** the majors could dispose of in our marketplace without infuriating their high ticket customers, that leaves us with just over 147 per month we need to produce on our own. Can we do it? Probably not.

In the antenna field we have Paraframe, Star Antenna, Starview Systems (H & R), Lindsey, ADM, and Chaparrel. Evenly split that is 24.5 antennas each per month. Or roughly one per day. But the orders **won't be** evently split; Paraframe has a high dollar product, Lindsey has to be shipped across the Canadian border and so on. Still, antennas are in better shape than receivers. In receivers we have AVCOM, ICM, Ramsey Elecronics and AB Electronics (VHF Engineering). That works out to 37 radios per month each. It could be done...but not this month and probably not next.

Where does this leave us? If you are a would-be-distributor, probably frustrated. You **want** to get into business but you can't. You **know** the market is there...possibly huge, certainly large. Unquestionably larger than the supply lines in place to fill it. Now, how do you get the gear out of the manufacturers????

CSD PROGRAMMING



COOP'S SATELLITE DIGEST (Programming Section) is produced monthly by Satellite Television Technology, P. O. Box G, Arcadia, Oklahoma 73007 (USA); 405-396-2574. **CSD** is not affiliated with any satellite programming source, hardware (equipment) manufacturer or distributor, nor satellite systems operator. STT does produce a weekly television program called **Satellite Magazine** which is distributed free of charge to viewers via RCA SATCOM FI at 12 noon eastern Thursdays on (SPN) transponder 21. Subscription rates to **CSD** are $50 per year for US, Canada and Mexico delivery; $75 per year outside (all via first-class/air mail). All subscriptions must be paid in advance in US funds; no invoicing.

INTELSAT

THE MORE WE KNOW — THE MORE WE DON'T

AFTER BRASILSAT...

The hypertension radiating throughout the Miami SPTS '80 gathering with the news that small (4 and 5 meter) dishes had brought down reasonably good quality signals from INTELSAT'a IV-A FI bird spread rapidly worldwide. Before too many people get too many ideas about what it is they think they can do with INTELSAT signals anyplace in the world we would all do well to carefully analyze the existing operational parameters of the INTELSAT system.

The operating parameters of the INTELSAT system are fairly widely known. The STT wallchart of Worldwide Communication Satellites tells us that the typical IV-A birds (there are some seven in the 'A' series and another seven in the straight 'IV' series) have carefully prescribed operating characteristics. Unfortunately there tends to be a wide range of operating charactistics in the **real** INTELSAT world and the wallchart data (it turns out) is more 'best case' than 'real case'.

Getting accurate data about the true operating condition of INTELSAT birds is difficult; perhaps impossible unless you have access to internal COMSAT records. There is reported to be a complete computer printout available to INTELSAT or COMSAT operations personnel that shows such things as the current operating condition, load (i.e. type of use), service hours and so on for each INTELSAT bird in the sky. Such a printout is reported to be updated monthly but unfortunately it is simply not available to the public (meaning you and I).

Therefore to put together a completely accurate picture of the current operating condition of any single INTELSAT bird, or any combination of INTELSAT birds requires a great deal of luck (and cooperation from informants) or a willingness to accept something less than complete data. We'll do our best given the shortage of verified data in this report.

NOT ALL EQUAL

INTELSAT IV birds are 3,120 pound satellites, spin stabilized, built by Hughes. They measure approximately 8 feet in diameter and are 17 feet high. Each is equipped with 12 transponder channels, 36 MHz wide. Under fully saturated conditions (i.e. the uplink signal into the satellite in the 6 GHz range is operating at a level to produce the maximum possible output from the downlink transponder) the IV satellites are **supposed** to produce minimum EIRPs of:

Global beam (which sees approximately 40% of the earth's surface) = **22 dBw**

Spot beam (available on two transponders, one with an eastern hemisphere spot and one with a western hemisphere spot) = **33.7 dBw** at boresight.

INTELSAT IV-A (the later series of the IV birds) are 3,340 pound spin stabilized satellites approximately 8 feet in diameter and some 23 feet tall. Each is equipped with a total of 20 transponders but only 12 can be operational at a time (36 MHz wide). The **global beam pattern** when the input is fully saturated **is 22 dBw** while there are potentially 4 transponders capable of operating in either eastern or western **hemispheric patterns** at fully saturated output levels of **26 dBw.** These satellites also have spot beam potential at the 29 dBw level.

The INTELSAT locations generally **publicized** are given in table one here. However while these are the 'reported' locations the true locations may vary slightly in some instances; as we are learning as we develop greater interests in the INTELSAT system. Other than Steve Birkill's work from Sheffield, England where he has been able to recover video utilizing his reduced bandwidth PLL (phase lock loop) system on a number of transponders, not a great deal of 'observer' activity has been conducted with the INTELSAT feeds; largely because where there is the most low-cost satellite terminal activity (within North America) the Canadian and US domestic satellites provide much more comfortable signal levels and easier targets. The limited success during SPTS '80 in Miami may indicate a change in this interest level, especially in the Caribbean and throughout central and South America.

THE BRASILSAT CASE

Brasil, like many of the countries utilizing INTELSAT, looks to INTELSAT as a (possibly) temporary substitude for having a domestic satellite system of their own. Since a single domestic bird, built and launched into position, carries a pre-bird price tag in the $50 to $70 million region (plus as much as 25 million for ground control and 'flight control' equipment and stations) the decision to launch a satellite on their own is not taken lightly by the lesser developed nations of the world. And since one satellite is risky (a back upbird is a necessity, usually in space with the primary bird) the true system costs for the uplink plus launching of a pair of birds really begins to look like a $150 million investment. And that is before the downlink terminals to receive the transmissions are included. If a nation only has to feed signals to the INTELSAT bird (as in having an uplink station) and take down (i.e. receive) the appropriate feeds, they can be in the satellite business for far less money; typically under $5 million, even with INTELSAT standard terminals. And when a nation only requires a **single** transponder, **or a part of one**, the cost effective decision is to go with INTELSAT since even with a 12 channel domestic bird a major portion of the bird's capabilities are lost or under utilized. On a cost-per-year basis, INTELSAT simply makes the most sense; even with the annual transponder rental charges of INTELSAT.

Because the (typically) 36 MHz wide transponders (same as domestic birds) are in a sense 'toll roads in the sky' INTELSAT encourages maximum utilization of each transponder. One way they do this is to push users requiring TV relay to utilize something called the 'one-half transponder format'. With this approach the 36 MHz wide channel is divided in half (i.e. it becomes **a pair** of 18 MHz wide transponders) and then with careful uplink engineering and control two separate video signals can utilize each half of the transponder independently from the other. Brazil does this with their utilization of INTELSAT IV-A FI located at 25.5 degrees west. The Brasilian video transmissions occupy the lower half of transponder II (the center frequency for their video carrier is 4143.0 MHz). This is the signal which the crowd at SPTS '80 Miami witnessed February 6th and 7th.

As noted earlier the power levels available 'on the ground' are nominally rated by the type of antenna beam being utilized. A '**Global Beam**' is similar in concept to an omni-direction antenna system for terrestrial use; the satellite using such a beam sprays signal onto all of the visible earth it can 'see' from the particular Clarke Orbit location; roughly 40% of the total earth's surface. Some transponders in both IV and IV-A satellites have the capability of being commanded into the other relatively common antenna configuration; hemispheric beams. In a sense the hemispheric beam sees approximately 50% of the global beam's area. For example, Brasil operates transponder II (half channel format) IV-A FI on a 'west up/west down' configuration. That simply means that t antennas receiving the 6 GHz range uplink signals and the antennas re-transmitting the 4 GHz range downlink signals have been directionalized by ground command to respond to that portion of the globe visible from 25.5 degrees west **to the west only**. See map figure one.

Brasil actually leases the full capacity of transponder II (in our example) but they choose to utilize only 50% of it for television. The other half, in this case, is utilized for telephone/data/narrow band communications and in Brasil's

instant case only perhaps 3 MHz of the remaining 18 MHz is so utilized. In effect Brasil has room to grow within its transponder II and could add additional narrow band channels (or on a temporary basis remove them entirely and run two separate and simultaneous TV transmissions).

POWER USE

As noted there are nominal published power (EIRP) levels for the INTELSAT satellites; i.e. under **ideal** conditions on a hemispheric beam you can expect 26 dBw coverage in the **worst** case.

Because the lifetime of the bird is affected by how much of its available power it utilizes how much of the time (i.e. operating a single transponder at a reduced output will usually lengthen the lifetime of the critical Traveling Wave Tube - TWT - output transmitter stage) INTELSAT encourages users to very carefully monitor their uplink power utilized to access the bird. Why is this? Remember that the individual transponders are really 'linear translators'. That means they repeat at the output (4 GHz) whatever arrives at the input (6 GHz). The **amount** of uplink power required depends upon the amount of downlink signal (i.e. EIRP power level) required. In other words, if the downlink receiving installations are employing large antennas, the uplink power can be 'backed off' and the circuit will still maintain a high signal to noise ratio. Conversely, when relatively small antennas (and non-cooled LNAs) are utilized at the downlink sites, the uplink power can be increased up to the point where the transponder 'saturates' (i.e. any further increases in uplink signal will not result in a corresponding increase in transponder downlink signal power).

INTELSAT, as noted, is very 'power conscious' which simply means they don't operate their transponders at anymore output power than the circuit requirements dictate.

NOMINAL INTELSAT LOCATIONS

While internal-to-INTELSAT data indicates that all of the IV and IVA series satellites are no longer precisely where previous published data says they should be, here is a table of that data. If you are utilizing a mount that allows you to adjust elevation angle on a single bird in the cluster for optimized reception, chances are you can then use a elevation siting tool on a flat surface on the rear of the dish to read-out the apparent elevation from your location. Utilizing this table, you should be able to search the sky + / - 10 to 15 degrees either side of your 'found' INTELSAT bird to pinpoint the locations of others in the cluster.

Satellite Number	Longitude
I-IV-F3	34.5W
I-IV-F4	179 E
I-IV-F5	60 E
I-IV-F8	174 E
I-IV-F1	121 E
I-IV-F2	4 W
I-IV-F7	1 W
I-IVA-F1	24.5W
I-IVA-F2	29.5W
I-IVA-F4	19.5W
I-IVA-F3	117E
I-IVA-F6	120E

This is another way of saying that INTELSAT engineers encourage users to put in **large receiving installations** (i.e. big antennas at the downlink site) so that in turn the transponders can be operated at reduced output power levels. And in fact a

INTELSAT IVA-FI - 24.5 [25.5] Degrees West

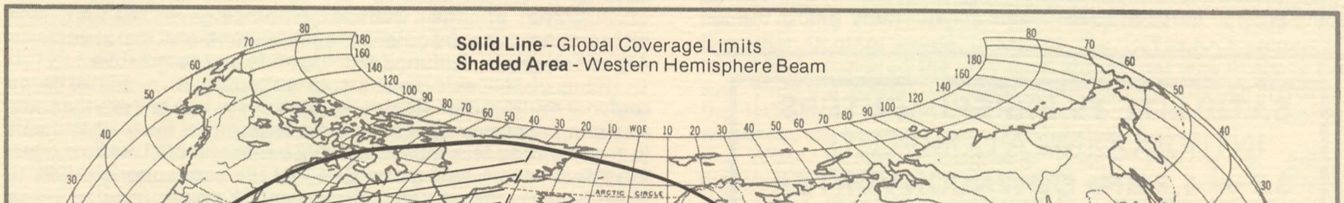


FIGURE ONE

considerable amount of INTELSAT engineering time is spent monitoring the power output levels of the various transponders in use and they actually 'police' the efficiency of the system on a daily basis.

Because of this 'reserve capacity' philosophy INTELSAT systems have remained very expensive to implement. The 26 dBw hemispheric beam transponders, for example, are certainly capable of delivering high quality television to ten meter (or slightly smaller) size antennas and while ten meter antennas are not inexpensive (they currently go for between $35,000 and $50,000 each) they are far less expensive than some of the 15 to 18 meter antennas which INTELSAT largely **encourages** users to put into service. And as SPTS Miami indicated, given a 26 dBw region hemispheric beam even antennas in the 5-7 meter class are capable of producing good quality (if not perfect) video.

GLOBAL USE

Television relayed by INTELSAT falls into two general categories. The first category is per-event-feeds; television relayed from the point of origin to one or more receiving points for the duration of the event only. The evening newscasts on the American and Canadian networks typically have several such 'events' fed to the network control center earlier in the day of broadcast. Sporting events, such as soccer, are another frequently noted type of programming in the 'per-event' category.

Per-event programs are typically sent via an INTELSAT Operated uplink through the appropriate transponder to a INTELSAT operated downlink. Terrestrial inter-connection on both ends of the circuit then completes the connection to (in the US case) the appropriate network control center. Because the downlink receiving station is an INTELSAT 'network' station, it is typically a large antenna with an extremely low noise (i.e. 20 to 40 degree K) cooled LNA. This simply says that the power-conscious (efficient minded) INTELSAT is not apt to run their uplink site transmitters at very much power during such a feed. Under these circumstances the program feed is apt to come back to earth at EIRP levels considerably below the 22 dBw normally considered as the operational plateau for global beams or 26 dBw for hemispheric beams.

The other category of programming one finds on INTELSAT is the domestic (i.e. **intra**-country) feeds typified by the BrasilSat service found on IV-A FI. In this situation the uplink and downlink sites are typically planned by the nation that is utilizing the system internally and they may create 'link power budgets' that suit their particular needs; with less attention to the INTELSAT desire to keep downlink terminals big and transponder EIRP down. Such feeds are more apt to be on a scheduled feed basis versus the per-event feeds typifying the first example. For example, a whole day's programming or a portion thereof is transmitted via INTELSAT. If there is news on the terrestrial system each day at 5 PM local time and sporting event each day at 6 PM, the INTELSAT use will parallel that feed. This type of domestic use of INTELSAT is quite popular in Africa and is starting to become more popular in the middle east. Some of these national users have been utilizing INTELSAT feeds as a temporary solution to a problem which they plan to eventually resolve with domestic satellites of their own, or with 'regional' multi-domestic satellites. Brasil, for example, has been alternately interested and dis-interested in designing and launching their own domestic satellite system for nearly six years. A consortium of North African and middle eastern nations have likewise been alternately interested and dis-interested in creating something named Arabsat; this would be (if indeed it comes off) a sharing of a satellite system designed to serve multiple nations in the same area of the world. Such a concept is already in operation in Indonesia where the Palapa series of satellites (2 birds) which were initially intended for use by that nation for intra-country service has begun to be shared with other nearby nations. The reason is obvious; lesser developed nations seldom require all of the capacity (of even a 12 transponder satellite) and in some instances can justify a satellite communications system only if they can share the system expense with other nations.

Some of the nations employing INTELSAT for intra-nation relay (of television, telephone and data) **include** Algeria, Nigeria, Sudan, Zaire, Uganda and soon Libya.

One of the side benefits to engaging in a domestic or regional multi-nation domestic satellite system are obvious. By confining the coverage pattern to a segment of the visible earth (i.e. something less than the global beam of INTELSAT or even the effective one-half-global beam of the hemispheric pattern) EIRP levels come up and both the uplink power requirements and the downlink antenna size (G/T) requirements come down. Since 4.5 meter receive-only terminals can be constructed for as little as 1/10th the cost of dedicated 10 meter terminals the nations employing such an approach are able to get more terrestrial ground coverage dollars for their money invested.

How do such nations utilize these INTELSAT feeds, for domestic service? Obviously they are not transmitting television programs to **individual** receivers (i.e. small aperture home receiver sites) with INTELSAT power levels. This is not a 'broadcasting satellite' service. The uplink site is typically located at a central program origination center (such as the nation's capitol) and the programming transmitted may be the normal over-the-air television released through standard broadcast transmitters for that portion of the country, or, it may be special programming created for the satellite feed (the Canadian ANIK-III system is an example of the latter while the ANIK-B 12 GHz fed channels of CBUT and CHAN is an example of the former). At the receive sites the downlink antennas recapture the satellite relayed signal and typically feed it directly into a (VHF or UHF) terrestrial transmitter. The 'viewers' then are simply watching off-the-air television, relayed to them via satellite but transmitted in their local area by a normal terrestrial transmitter. This type of service may on occasions be intended for non-contiguous portions of a nation such as the Spain feed of the TVE network to the Canary Islands.

GIVEN THESE CONSIDERATIONS...

With the power efficiency concern of INTELSAT plus the transponder rental charged by INTELSAT to users there is give

and take on both sides. Since a good quality TV signal can be transmitted with reduced modulation indexes (i.e. the so-called 1/2 transponder format modulates to a maximum deviation of 17.5 MHz) this encourages nations such as Brasil to lease something **less than** a full transponder for video. In Brasil's case they do lease all of transponder II on IV-A FI but they then utilize the second half of that transponder for narrow band services (in Brasil's case their present use of the 'second half' of transponder II centers on 4136.5 MHz, they utilize but 2.5 MHz of the space with approximately 36 narrow band service channels).

Some nations lease only half of a transponder and only transmit video. Libya's 1980 start-up system is an example of this. Other nations with no video requirements lease even less than half transponder from INTELSAT; Egypt, for example, recently indicated it wishes to lease 1/4 transponder for what will be narrow band service connections. In our hemisphere Chile leases a part of a transponder largely for telephone traffic (transponder II on IV-A F4 at 30 degrees west).

Most of the present 'continuously-up' traffic on INTELSAT is in fact non-video. Narrow band services require lower EIRP levels for 'noise-free' reception and this use again allows INTELSAT to design the system so that the transponder can run at 'backed-off' (meaning reduced) transponder power levels. Why is this worth mentioning? Because as you dial through the INTELSAT channels you are likely to find that the power levels present vary considerably from transponder to transponder even when they are operating in the same antenna pattern configuration (i.e. all global for example). Each user (with the guidance and agreement of INTELSAT) configures his own uplink/downlink 'power budget' to suit both his service needs (i.e. whether narrow band or wideband video) and his system engineering requirements (i.e. whether the service is being utilized by 'small' (in this case 10 meter) receive antennas). Algeria's total of 14 terminals are all 10 meter, for example.

While INTELSAT has available global, hemispheric and 'spot' beams a recent survey of the actual in-service transponders revealed that generally speaking hemispheric beams are not widely used; again the power consciousness of INTELSAT engineering. The most common transponder for video for per-event relay is transponder 12 and this has a (1/2 transponder) video center frequency of 4184.25 MHz. The Pacific cluster of INTELSAT birds (two, one in operation at 174 degree east / 186 degrees west and the other in reserve status at 179 degrees east / 181 degrees west) is typical. While it is possible to configure on command from the ground virtually any transponder to carry any type of traffic, the video-use transponder (12) is quite universal for that 'dedicated' purpose worldwide. As noted the video center frequency for transponder 12 is typically 4184.25 for the higher half of the split transponder and the center frequency for the lower portion is 4165.75 MHz. What about full-transponder video (i.e. utilizing the full 36 MHz)? It is very seldom utilized.

The spot beam option is also seldom utilized. Where perhaps 90% of the transmission services are operating on the global beam, even the hemispheric beam is the exception. So what does this mean relative to expected EIRP levels in various segments of the world?

First of all, EIRP levels are always link-budget conscious. Take the utilization of transponder 8 on IV F8 located at 174 degrees east. There are presently approximately 130 channels of narrowband data on this transponder in a 10 MHz bandwidth. The power level radiated is in the **19.5 dBw region** in the global beam (rather than the 22 dBw the system is capable of) simply because of the link-budget which includes the gain and G/T of the receive terminal(s) associated with this particular transponder.

Global TV transmissions on (typically) transponder 12, widely utilized for per-event feeds, may be powered-down even more severely (again a function of the G/T of the receiving site). On IV-F4 (18.5 degrees west) for example, widely utilized for cross-Atlantic news feeds, the 'nominal' (i.e. maximum) operating EIRP is characterized as 22 dBw while the recent operating EIRP has been in the 17 dBw region.

What does all of this tell us? Simply that unless the INTELSAT channel you are after is on a hemispheric beam pattern, and you are located in the 'correct' hemisphere, you won't repeat the SPTS Miami results! Let's look more closely at what the Miami 'pioneers' were apparently working with when they produced 5.5 to 6.0 dB CNRs with the 5 meter Paraframe antenna plus 120 degree K LNA and the H. Paul Shuch Microcomm 'next-generation' TVRO receiver.

1] The video was operating in a **1/2 transponder** format centered on 4143 MHz.

2]Audio was **subcarrier** at 6.6 MHz.

3]The transponder and antenna configuration was for a 'west up' and a 'west down' **hemispheric** pattern. That means the system was looking at the western portion of the 'visible portion of the earth' and the signal level in Miami would be very similar to the signal level in Brasil proper.

What about the EIRP level? Apparently the Brasilian receive terminals associated with this feed are on the 'skinny side' when it comes to G/T since INTELSAT data indicates the EIRP would be in the 26.5 dBw region. Yes, that is approximately 0.5 dB **above** the reported 'nominal-maximum' one could expect from INTELSAT on a hemispheric beam.

The receivers connected to the Paraframe antenna for this experiment were all designed for domestic service. One (the AVCOM) utilizes a conventional discriminator while the balance (VHF Engineering, Shuch prototype and the ICM production unit) all use PLL demodulators. As was noted, the PLL receivers produced superior pictures on this below-threshold carrier level. None of the receivers had 17.5 MHz IF bandwidths which simply means the receivers could be expected in the best case to recover perhaps an additional 3 dB of video SNR (signal-noise ratio) if they had optimized IF bandwidths for the one-half transponder modulation index. And also this reminder - INTELSAT transmissions are all circular polarized and when you receive such a transmission on a linear (whether vertical or horizontal) feed 'probe' you immediately give up 3 dB of received signal 'power' by seeing only 50% of the incoming wavefront.

It turns out that apparently the only **western** hemispheric pattern signal over the Atlantic at the present time, on a **regular** basis, is the IV-FI signal on transponder II utilized by BrasilSat. In other words, in Miami, the 'INTELSAT pioneers' found and recovered the only such signal that was likely to be seen even if a search had been conducted through all (five) of the INTELSAT Atlantic birds 'visible' from Miami. Some would say the Miami crowd was frightfully lucky!

What about hemispheric beams looking in other directions? Information is scarce at the present time; INTELSAT operations continues to guard the data closely. However, there are some obvious examples known. Spain's TVE feed on transponder 7 of IV F4 (30 degrees west) is on an east/east hemispheric beam (east looking uplink antenna and east looking downlink antenna). What is the EIRP level on this service? Hard to say but one knowledgeable source indicates it does not exceed 23 dBw (although Steve Birkill's observations in Sheffield, England suggest it may indeed be closer to the 26

dBw region of BrasilSat). The Spain service, incidentally, is something of a benchmark in the sky since it is in service every day and is highly reliable at 3984.25 MHz. The important thing to keep in mind with any hemispheric pattern is that the hemisphere is divided along north-south lines with everything east of the satellite being the eastern beam and everything west being the western beam. This means that the eastern hemispheric pattern for Spain's TVE feed is at the same level in southern Africa as it is in Spain or the Canary islands even though they are on opposite sides of the equator.

BOTTOM LINE...

Much less is really known about INTELSAT than is known. The US/Canadian domestic satellite systems are relatively well understood and through several years of editorial 'prying' many of the details have appeared in print and been updated as conditions changed. INTELSAT has greater bird flexibility with the ability to change antenna patterns on several transponders per bird and to activate less than full transponder formats. And perhaps of greatest importance, because the power budget for every user is carefully controlled and calculated the actual EIRPs present can vary over a range of perhaps 5 dB downward from the published (i.e. 'nominal') levels. All of this says that INTELSAT watching on other than dedicated feeds (such as TVE, BrasilSat and others) may be out of the reach of truly small terminals for now.

Do remember that any INTELSAT signal you intercept with video is going to be circularily polarized and probably operating on a half transponder format. And this says that if you can get even a set of 'sync bars' with a linear feed and a standard IF bandwidth receiver that by improving the system to include a circular polarized feed (such as the Birkill Hybrid Mode feed described in the February **CSD** / Technical Section) you can pick up 3 more dB (and start to begin watching a picture). Furthermore, if you will then work with the receiver IF bandwidth (to narrow it down to the 17.5 MHz point) you probably can pick up additional dB or two of video SNR. The PLL demodulators originated by Steve Birkill and Taylor Howard have the capacity to semi-automatically reduce their own demodulator bandwidth to the video bandwidth present. In some circumstances when you start off using a receiver with such a demodulator system you will not realize the full SNR improvement normally associated (in theory) with reducing the IF bandwidth of the system.

One other note worth remembering. Because the normal INTELSAT video is operating at a 1/2 transponder format, a switch tuned (i.e. preset channel by channel) tuning system may not be as functional as a continuously tuned receiver. **Why?** Simply because the **half** transponder video signal is always going to be **above or below** the **center** frequency (i.e. 18 MHz above and below the center of the channel to which the radio's pre-set tuning is calibrated). This says that if you are going to be recovering with maximum efficiency all of the video information present, with a reduced IF bandwidth system tailored for the INTELSAT service, you really need to be able to 'fine tune' (as in continuously tune) the spectrum.

INTERVIEW WITH COOP

While CSD attempts to deal with the burning issues of the day through both feature reports and the publication of letters to STT/CSD, the lingering effects of a gathering such as the recent SPTS '80/Miami suggests to us that not all of the desired information is getting into print. Recently two organizations with a desire to share Coop's experience and knowledge in this field visited STT to interview him. Representing **Mother Earth News**, Associate Editor Peter Hemingson spent the better part of a day with Coop talking about and transcribing views on the history of television broadcasting in this country and the future of satellite television 'narrow-casting'. A few days later the Japanese Broadcasting Network **NHK** spent a full day at the Coopers preparing a special program which was to air in Japan during prime time late in March. STT took the opportunity of both visits to do a little coverage of our own, videotaping for use on our Satellite Magazine program the NHK visit and transcribing for use here some of the conversations with Mother's Peter Hemingson. An abbreviated text of the two interviews, as if they were one, appears here.

NHK: How do you explain the American phenominon of low cost satellite television equipment?

Coop: Individual initiative. In fact the low cost satellite revolution is totally the result of individual people working on their own projects and then sharing their results with others. Taylor Howard, for example, built a terminal for his own use. He did it because it was a challenge to see if it could be done. Then through us he agreed to share his experience and knowledge with others.

MOTHER: How much longer can individual initiative lead this evolution? Isn't there the liklihood that low cost earth terminals will become so widespread and such a success that major firms will recognize the potential of this market and jump in, pushing the individual entrepreneur such as Howard or Coleman aside?

Coop: Certainly at some point that will happen. But I have this theory that tells me that as long as the 4 GHz satellite service continues to have these program access legal clouds hanging overhead that most major firms will stay out of the business.

MOTHER: I am confused how people can dis-regard the legal questions that apparently do, as you say, cloud the right to access programs, and charge ahead building and selling terminals.

Coop: It doesn't baffle me. Taylor Howard is not General Motors and he doesn't have that corporate legal staff telling him to go slow because there are unresolved legal questions. He continues to be challenged by just doing it; he is an engineer's engineer. He sees a challenge to design a box to do a specific task and he sees people interested in what he is doing. So he just does it.

NHK: In Japan virtually all research and development is carried out by large corporations. Often the seed money for this will come from government or quasi-government agencies. Our BSE satellite, for example, may have been launched just so our electronics industry would then be placed into a position of designing and producing low cost receiving hardware for 12 GHz. Yet here in America there seems to be no government incentives in this area at all.

Coop: Certainly there are no direct incentives such as grants or funding. But in a sense when our FCC decided last October to deregulate receive only earth terminals, that provided a form of incentive. Prior to last October 18th an earth station had to be licensed to be built. By eliminating that mandatory licensing a major element in the murky legal structure overshadowing all that we are attempting to do was eliminated. I think that was a direct incentive to individuals and corporations to get busy developing the technology we are now seeing.

NHK: Yet there are many major firms, certainly firms large enough to produce large quantities of receiving systems, already in this field. Firms such as Scientific Atlanta,

Microwave Associates, Microdyne and Gardiner all have been selling hardware in this field to the commercial users for several years. Why aren't they aggressively entering this private marketplace since their product lines and manufacturing facilities are already established?

Coop: Largely because of pressures on their existing production capabilities and pressures from their existing customers. My intelligence tells me that if you add up the production capabilities of all of the major suppliers in this field you come to fewer than 1,000 new TVRO **radios** per month. The commercial installations, meaning the cable firms, hotels and so on, typically now install around 5 **separate receivers** at each receiving site so as to be able to handle that many simultaneous program channels. Working backwards, that says 200 new commercial **terminals** per month. In my estimate the flat-out production capabilities of the receiver suppliers in the commercial field just about presently equals the demand of that segment of the market. At best there may be 200 extra receivers per month left over.

MOTHER: That brings up the questions of receiver differences and pricing. We see private terminal receivers priced as low as $1800 for a 24 channel tuneable receiver. Yet the commercial radios are as much as 2 or 3 times that amount. What is the real difference here?

Coop: Surprisingly little. There are refinements on the commercial radios and greater safety margins. However given an adequate signal level from the antenna and LNA you can stack two radios, one intended for commercial and one intended for private, side by side and the pictures will look almost or exactly the same.

MOTHER: Why do cable and other commercial buyers spend more money for receivers when these lower cost units are available then?

Coop: Pride and sales packaging. Their pride keeps them from buying what they believe is an inferior product. Sales packaging, meaning the whole package of LNA, antenna, receiver plus add-on equipment that is only required for commercial installations, is often done in such a way that if a buyer elects a Scientific Atlanta TVRO for example he can then obtain some pricing discounts on regular CATV hardware also purchased from SA.

NHK: I am confused by the Scientific Atlanta attitude. Didn't they initially say they were going to sell private terminals through a subsidiary called HOMESAT? And then they seemed to get totally out of the business.

Coop: They did and I believe they left the private market because of a combination of factors. The most significant factor may well have been the pressures they were feeling from commercial buyers.

MOTHER: What kinds of pressure?

Coop: Well, I haven't been there to hear it; all I have heard is second or third hand reports. Basically it appears the cable buyers in particular have let SA know that if SA is attempting to sell on both sides of the fence...that is, to commercial users and private users, they can forget about selling to the commercial field.

MOTHER: Why should the commercial users have this attitude?

Coop: Paranoia. When the first cable satellite installations were installed in September of 1975 and HBO became available via satellite the cable industry got the biggest shot in the pocketbook it has ever had. The satellite revolution to cable has met the difference between a ho-hum industry growing slow but steady and an industry that has taken off like a rocket. The value of cable systems has doubled or even tripled in recent years strictly because of the additional cash flow that satellite signals create for cable systems. So we have around 4,500 separate cable systems all dependent upon their 'exclusive-by-cable' services from satellite who recognize that the sudden increase in the value of their businesses is a function of their having exclusive access to the satellite signals. Private terminals represent a wedge on that exclusivity. It doesn't amount to a hill of beans yet. But someday it might and that scares them to death.

NHK: This fear then is extending to the suppliers?

Coop: Definitely. Didn't you have an example of that when you tried to interview some people at SA?

NHK: Yes, we were in Atlanta to visit with Ted Turner and while there we attempted to visit Scientific Atlanta. We wanted to interview some of their people and to videotape some of their operations.

Coop: And what happened?

NHK: We were told that we would not be permitted to interview anyone and that we could not videotape anything there. They acted as if we were spies!

MOTHER: That raises the question of what will happen offshore with the equipment. If the US manaufacturers are operating at full bore to supply the commercial market and it appears the newly formed firms that are attempting to sell terminal equipment to private users are at best small in size and production capabilities, isn't that exactly the scenario needed to bring someone like the Japanese into the marketplace?

Coop: I think it is only a matter of time. Again, though, I see the murky legal picture having some calming effect on the ultimate decision by any major offshore producer to jump into this market. Perhaps the legal questions will not be as big a consideration for say a Japanese firm as they might be for a US firm, but they remain none the less. All it takes is one decision to change that situation. I believe that when the first offshore producer decides to risk the fallout that is sure to come when thousands of truly low cost terminals start entering San Francisco harbor all sorts of things will happen.

MOTHER: Such as...?

Coop: Well, we'll have great cries of anger from the established US commercial suppliers. They'll bombard Congress with requests that these 'illegal receiving units' be banned from distribution in this country. We'll have Congressman standing up and reading into the Congressional Record their beliefs that our whole national system of FCC regulated broadcasting is in danger.

NHK: And then what?

Coop: If I were directing an offshore firm I'd avoid that scenario from the beginning. First of all I wouldn't even call the terminal hardware I was importing into the United States 'private'. I'd announce it as a 'breakthrough' in high quality **professional** hardware designed for the **commercial** market.

NHK: What would that do?

Coop: Commercial systems have no murky legal problems. The cable firms and others have clear contractural rights for the programming available on satellite. This is why SA and others have no problems in that area. By promoting what they should call low-cost-but-professional, as in high quality, equipment directly to the commercial market they will avoid the pitfalls of scaring up a mad Congress.

MOTHER: But how does that help them sell the hardware in the private sector?

Coop: Simple enough...while I strongly disagreed with what happened or how it happened, there is ample precedent in the CB field. Some years ago a number of reasonably high quality Japanese amateur radio transceivers were introduced here under the guise of being ham radios. In truth they were being sold at a 10 to 1 or higher ratio to CB enthusiasts. I am told that even today, years after the bloom has fallen off the CB rose, that for every Japanese ham radio transceiver sold to an end ham user that several are sold to an end user CBer. Yet clearly these radios are totally illegal for CB use.

MOTHER: In other words, call it what you want and then let the marketplace decides who buys it?

Coop: Precisely.

MOTHER: Are you in favor of such a subversion of the law?

Coop: What law? There is no law at the present time. What there is out there is a lack of law.

MOTHER: Well, let me re-phrase the question. Are you in favor of abdicating the American developed marketplace for low cost satellite hardware to offshore producers?

Coop: Not at all. I am trying to give my views on what I think is inevitable as long as we have this split marketplace where the large firms who **are** capable of seeing that this does not happen refuse to become a part of this marketplace. I think that they are the ones who will ultimately abdicate the marketplace to offshore producers. This is such a potentially huge market, not

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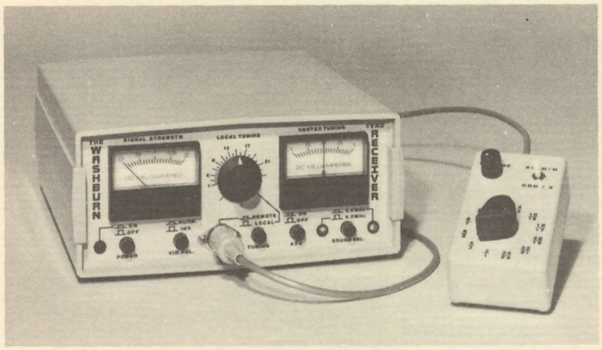

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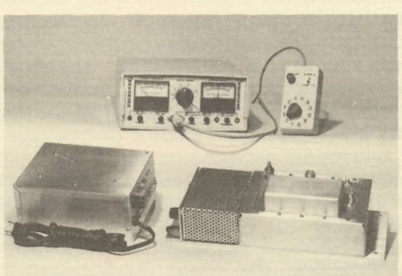

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only at home but worldwide, that they need to be concerned that by artificially restraining distribution of their hardware in the US private sector that **they** are creating a scenario which can only be solved by the entry of offshore producers.

NHK: What about the present firms supplying hardware to the private marketplace? Are any of them capable of handling the business that seems to have been generated by your Miami Seminar?

Coop: Not today. I firmly believe that there is a market right now, today, for no fewer than 1,000 private terminals per month in this country. And that overlooks the needs outside of the US, such as in Canada, the Caribbean and so on. If the commercial producers are capable of turning out 200 new terminals a month with an average of 5 receivers per terminal, the private sector manufacturers will do well to crank out 200 terminals more with 1 radio per terminal.

MOTHER: In other words it is a seller's market?

Coop: Yes, but that is not the total answer. It is still an engineer's market. By that I mean the suppliers in this field are, almost without exception, run by engineers. And engineers are people who are never happy with their present design; they are always thinking a generation or two ahead. We need some savvy marketing people to get into this market and freeze designs and start the production lines rolling. Instead, we have firms turning out 15 or 25 radios a month, changing the design and losing a month, and then turning out another month or two of production before they again change the design.

NHK: Isn't it important to keep on designing and re-designing a piece of hardware like a receiver to keep the latest technology in the current models?

Coop: It is my opinion that any radio that works would sell today as long as the price was between $1500 and $2500. I have great admiration for people like Clyde Washburn and Paul Shuch who are constantly making their designs better. But at some point in this development we need 500 radios per month popping off the production line. What product do you buy today that won't be better if you waited until next year to buy? It is ludicrous to believe that you can't tool up for volume production because you fear you will be outclassed by someone with later technology next month. If Henry Ford had adopted that attitude we'd all still be traveling by horse and buggy.

MOTHER: Isn't there a chicken and egg scenario here? We have a handful of small suppliers who probably got started with a few tens of thousands of dollars of invested capital plus thousands of donated hours of time. They have to crawl before they can walk. How can they jump from 25 units a month to 500 units per month?

Coop: By changing their underwear. They have been so concerned with not starving and staying alive that they have worn the same under garments from the day they first decided to get started in this field. Now they are swamped with orders and they see a light at the end of the tunnel. What they don't realize is that this is not a seller's market as long as there are unhappy buyers. Unhappy buyers are people who have the money to purchase 25 units per month and the inclination to do so; but when they go to buy their equipment they find that the best they can get is 5 systems a month. This is an intolerable situation that will last only so long. The longer this situation persists the sooner we'll see offshore imports in this country.

MOTHER: So you say they are in the convenient mold which they are reluctant to break?

Coop: Precisely. Each in his own way wants to increase production but each has some factor in his business operation or makeup which prevents him from really accepting the magnitude of the market and doing something about it.

NHK: Is there a solution to this?

Coop: I suspect there is; it is a classic problem of any rapidly growing industry. I think anyone sitting there as a manufacturer with orders for 3 or 6 or 10 times his present monthly production capabilities can find financing to increase his production capabilities. But he is going to have to give up some of his ownership rights in the process.

MOTHER: Which one suspects the present owner is unwilling to do?

Coop: Of course he is. He remembers the hard times, the hundreds or thousands of hours he donated to the project to get it off the ground, and he figures that anyone coming in now with pure cash is not entitled to any more than participation; certainly not control.

NHK: But you are suggesting that you don't think these present manufacturers really understand how tenuous their present position is?

Coop: I doubt most of them do. The reality of what will happen in this market if they don't start cranking out equipment in big volumes hasn't hit most of them yet. They are just starting to make money, just starting to repay the debt in money and time they built up in the formation of their businesses. They want to hold onto what they now have and hope they can survive when the shakeout comes.

MOTHER: A shakeout - you mean fewer firms producing hardware?

Coop: Ultimately, yes. But more likely there will be a period of acquisitions and mergers before that happens. Keep in mind that as long as we have this unresolved legal question of program rights access the big firms with lots of money to invest are going to stay out.

MOTHER: How long can the present industry simply ignore what you refer to as a murky legal picture?

Coop: No longer. I was very pleased to see a push from the attendees at the Miami Seminar to form an international trade association. I am happy to report that just such a group, known by the accronym SPACE which stands for 'Society (for) Private And Commercial Earth (terminals)' is now actively pursuing both memberships and doing extensive research on the legal battles to come. I have been preaching that this young industry cannot sit back and wait for the first full blown legal attack; it needs to create a strong offense going in. There's an old saying that the best defense is a strong offense.

NHK: What part are you personally, or Susan, playing in SPACE?

Coop: I am an unpaid and untitled advisor. They call me up to discuss their problems and solutions. They can take my advice or dis-regard it; I am not offended either way. I have offered a page in **CSD** to them to report on their activities and I believe that by May or June they will be using that space for that purpose. I have also donated a booth space to them for the California SPTS this summer where they will be actively soliciting memberships.

NHK: If you had a million dollars given to you tax free today with the only string attached being that you must spend it in a way that would enhance the growth and foundation of the low cost satellite hardware field, how would you spend that money?

Coop: That's an easy one. First I would see that the new SPACE group had the very best legal and research people it needed . We have got to address this murky legal question and the sooner it gets done the sooner we will have a completely clear title to the land many claim we are now poaching on. Then

with whatever was left I would establish a non-profit foundation that would engage the services of a small but very talented group of engineers and technicians whom I would personally direct to develop truly low cost hardware and systems. Whatever this research foundation developed would be available by license to any qualified manufacturer in the world. From these licensing fees the initial seed money in the foundation would be turned over so that the foundation could continue to develop hardware innovations for as long as such an effort was needed.

MOTHER: Wouldn't that be in conflict with private industry doing the same kind of developmental work.

Coop: Not at all. Private industry develops only products which suit the needs of that particular coporate philosophy. A foundation such as I envision would look at the **total needs** of the satellite communications field and it would draw upon the very private individuals such as Howard, Coleman, Washburn, Shuch and England's Steve Birkill who have gotten us where we are today. A foundation like this would recognize that purely private people such as these can make outstanding contributions to technology even when each such person is working on their own with nothing driving them to succeed but the challenge of accomplishment. The motivation for Steve Birkill, for example, is purely the challenge; he is not operating under any corporate guidelines nor under corporate goals. This is a very important element of our technology and it needs to be encouraged and more important it needs to be coordinated. They say that space is the final frontier. It may not be the last one but for right now it is the big one. I happen to believe that individuals with a talent can make very important contributions to where all of this is headed. It's that same spirit that used to dominate the amateur radio field years ago; it is still alive and well on dozens if not hundreds of garage workshop benches all over the world. People working on their own like this don't know the meaning of the phrase "You **can't** do that...". I would like to have some sound way to encourage this continued individual work and then to insure that when such work pays off the developer gets a fair shake from industry for the rights to his idea. Each such success will generate dozens of additional individual efforts. That's the most important factor in the development of this field to date. Individual effort that is ultimately shared with everyone.

MOTHER: Has anyone offered to fund such an effort?

Coop: No, I've never even discussed it publicly before. It is simply my concept of how something that started as a grass-roots American technology can continue along in that same vein. I believe American ingenuity, although I wouldn't limit it to American participation, is still alive and well and the foundation I envision would create a privately endowed vehicle to insure that as this whole telecommunications revolution sweeps the world American know-how stays out in front of the other national interests.

PROGRAMMING CORRESPONDENCE

SPTS '80/MIAMI

Perhaps if you are giving this a 'title' you should call it "Don't talk when you should be listening...**or you may get put to work!**". My brother Charles and I arrived at Miami the day before the event began and we were looking over the antennas being set up and visiting with others doing the same thing. One of the SPTS attendees we ran into was David Weeks of Delray Beach (FL). Since Dave Weeks' occupation is similar to mine (each of us own and operate a couple of small CATV systems) and since his interests in TVRO work was also similar to mine, and, since, we were both interested in flying and scuba diving we naturally had a lot to talk about. Especially since we had brought complete scuba gear to Florida with us and Dave Weeks knew all of the best places to go. What we didn't realize at the time was that contrary to popular misconception, Florida is (or at least can be) **cold** in February. Nevertheless Dave told us all about the best places to dive and what to look for and even offered to take us out in his boat if we could stay through the weekend.

In retaliation I tried to explain to him how to build a TVRO antenna like mine; it is a very simple antenna but the simplicity of the antenna seems to be the very thing that makes it difficult to understand without a detailed set of plans. We saw Dave the next day (Tuesday) after spending the night in a hotel. I wouldn't want to say the hotel was raunchy or ratty or dirty...so I won't say anything about it. However after one night of staying there we decided to sleep in our van the rest of the time! Dave, it seemed, had a couple of empty bedrooms at his place in Delray Beach and he had decided to try to build my antenna but he needed a bit more help. The end result was we spent the next 3 nights at his place and built him a TVRO antenna.

Meanwhile, back at Miami, I met up with Joni and David Brough (we had gotten acquainted at the first SPTS in Oklahoma City). He found out what we were planning on Wednesday night so the Broughs and Mrs. Oliver Swan came up to Delray Beach to see what we were doing.

I was very impressed with Mrs. Swan; she seems to be such a nice, decent lady. I told her about meeting Oliver last August and how he had influenced me and made me realize that building an antenna wasn't too complicated if you just go ahead and do it. It seemed to please her that we were using Oliver's design and putting it to practical use.

Wednesday we had only the lattice material. We used 1 x 2 (really 3/4 x 1-1/2) redwood strips. So Thursday after SPTS concluded we (my brother, Dave Weeks, his dad, a friend of Daves named John Williams and the Broughs, with me of course) gathered up the frame material (we used 2 x 2 aluminum angle to prevent rust problems) and assembled the antenna. We got started late but stopped around 10:30 that night with the antenna ready for the window screen. At that point it would take two people about a half day to complete the assembly, set it up and adjust.

So sometimes it seems the side effects of SPTS are nearly as great as the main event. Keep up the good work.

H. D. McCullough
Salem, Arkansas 72576

Indeed! We were delighted that Veleda Swan was able to join us in Miami for a portion of the seminar and we knew she had been escorted by Dave and Joni 'up the coast' one evening; but had no idea what was up. McCullough apparently has the Swan TVRO Antenna duplication 'tricks' down pat; see separate report in our Technical Section this month.

IN THE CAN

Over a year ago I ordered one of your manuals and have worked it into a purchase proposal for an earth station here at the Arizona State Prison Complex. Now we have the money set aside for the system but have run into a problem; deciding which of two suppliers to choose from. I would like to give you a rundown of the equipment being proposed and ask your advice on which equipment we should buy. Comtech of Tempe, Arizona are offering us their own receiver, their own antenna and a LNA from Amplica. This would be a five meter dish with a prime focus. Gardiner Communications of Houston, TX

suggests we purchase their 4.6 meter dish with a Cassegrain feed system, their SCI LNA and the SCI receiver. Can you help us decide?

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Box B #34860
Florence, AZ 85232

Both Comtech (which has **not** been active in the private TVRO field) **and Gardiner manufacture good gear. The differences between the two systems on paper are all but not measureable. Which brings us down to price; if one is appreciably lower in bid to you than the other, buy that one. If the two are comparable in price, look at the delivery schedule** (we assume you are in a hurry to get it!). **Finally if everything else looks comparable between the two, look at the proximity of each; Tempe is closer than Houston and if there are problems in theory you would get faster service from Tempe. All that aside, we are intrigued by what may be the first** in-prison TVRO system **and salute you for pulling it off. However, we would not want to be responsible for deciding which transponder that receiver is tuned to; some of those viewers could get flat mean!**

BIG RESPONSE

Thank you for mentioning our company in Coop's articles appearing in **Popular Science** and **Radio Electronics**. The response has been overwhelming!!! We are averaging over thirty pieces of mail per day from all over the world; including South America, Mexico, Alaska, Caribbean and so on. We desperately need up to date footprint maps for these outside of US areas so we can properly repond to these people who seem desperate for television. Can CSD help?

Bob C. Mooney
Satellite Television Systems
Reno, NV 89510

We too have had a big response from the current series of Coop articles running; especially Popular Science. The latest footprint maps are the old footprint maps; i.e. as shown on the rear of the Satellite Wallchart. Basically, as was discussed in great depth at SPTS '80 Miami in several sessions EIRP's in areas such as the Caribbean and northern South America are in the 28 dBw and below [way below like 18 on the extremes] regions. In fact the INTELSAT BrazilSat hemispheric beam is hotter [27 dBw] than the US domestics in much of this area. The truth is domestic satellite footprint maps outside of the continental US are at best guesses by the fellow who prepared them. The first terminal in each area will have to pioneer...and risk some money that there is in fact usable signal available there.

REMEMBERS OLIVER

Your very nice tribute to Oliver Swan will surely inspire other cable technicians and managers to better serve the people who want better television through cable. That the smallest of cable systems can lead the rest of us in techniques and technology shows how very young our industry still is.

Peter Kendrick
Home Theater Network
Portland, Maine 04101

Oliver Swan passed away late this past December but the pioneering work he began will be with us for decades to come.

PREMIUM BACK ISSUES

I enjoy **CSD** and the informative technical and programming articles. I hope to have a system in operation by the end of this year more or less following the Coleman and Howard manuals plus the updates in **CSD**. However I am missing the October issue of the Digest and while I understand no more copies are available from you I wonder if one of your readers who is finished with his copy would be willing to sell it? I would hope that it would be in good shape, complete with both the Technical and Programming sections along with the cover.

The closer it is to a new condition, minus tears, stains and doodles the more I would be willing to pay. Also I would like to ask that **CSD** run some articles on antenna mounts, antenna positioning controls and the techniques utilized to measure signals.

Reginald M. Wagner
10916-153 Street
Edmonton, Alberta T5P 2E2
Canada

We hope you find an October issue but doubt it; CSD **back issues have appreciated in value several times faster than the run-away inflation rate! Susan [Cooper] has carefully stuck a dozen or so copies away in a safe place for each issue and she says she is going to send the kids through college by selling them off someday! Antenna mounts - we'd like to have some field data to turn into articles. Field strength measurements - utilizing the TVRO receiver, coming up in May.**

DEED RESTRICTIONS

I would like to know if anyone has successfully installed an antenna in an out-house. I have run into a problem with deed restrictions on antenna in our sub-division. Are there other alternatives to 'hiding' a ten foot dish antenna?

Don H. Morrison
681 Lockmore Ct.
Rochester, MI 48063

There are some possible solutions. Depending upon one's look angle to the bird[s] you can submerge the dish below ground line (partially or completely) **in a hole. Calculate your look angle to FI and then take some scaled graph paper and determine how far below ground you can drop the base of the parabolic surface and still achieve the desired look angle clearance on the side of the hole. You may get as much as several feet of reduction in antenna height that way and as Dan Yost of COMPUCON would point out getting the antenna down in the ground will reduce the susceptibility to terrestrial interference** (the ground is a great blockage to 4 GHz telco circuit signals). **Others have placed a geodesic dome over their antennas** (plastic or fiberglass covered) **under the guise of creating a small 'green house'** (see gardening publications for advertisements for $100 to $500 domes like this). **Deed restrictions against antennas are a problem; several Canadian CATV firms in the Toronto area recently tried to stop installations of Canadian private terminals by bringing the deed restrictions and zoning restrictions on the books to the attention of the authorities; hoping that they would shut off private terminal growth in Canada in this way. Our suggestion is simpler than any of this. We suggest you not call the dish an 'antenna'. It is simply a 'solar collector'. Are you not interested in experimenting with solar heating and is that 10 foot dish not truly an experimental solar heating system? In other words,** call it something else; **something not covered by zoning or deed restrictions. As noted in the March** CSD **[see Programming Section Jim Vines of Paraframe imported a**

parabolic into Canada by calling it a solar collector; if it worked for Jim it can work for you!

SOMETHING HAPPENING HERE?

I have read Bob Cooper's article in the January 1980 edition of IEE News with regard to small satellite television receiving systems. Our firm, Electrical Equipment Limited, is a major electrical company in Australia. At the present time the Australian Government is looking into the establishment of a domestic satellite television (and narrow band communications) satellite and once that is in place the market for home receivers could well develop in a way similar to the United States. What are your thoughts as to the development of the Australian market?

P. T. Nicholson
Electrical Equipment Ltd.
Sydney, N.S.W., Australia

The Australian domestic satellite system, when operational in the mid 80's [at the earliest] will be in the 12 GHz band. Details of the system are still being worked out in preliminary planning but it appears that 2-3 foot receive antennas plus 4.5 dB [or better perhaps by the mid 1980's] noise figure front ends will produce high quality video with receive terminals which may be priced to the end user in the $700 to $1,000 [American] region by that time. We understand there is the possibility that as an interim measure Australia may lease a transponder from INTELSAT using the present 4 GHz service band. Based upon our SPTS '80/Miami testing, if INTELSAT provided a hemispheric beam to Australia for this service reasonably good quality television (8 dB CNR) **could be provided to 4.5 to 6 meter terminals with 120 K LNAs. One advantage to this interim service would be that by using a hemispheric beam the coverage would extend from approximately the International Dateline - west, north and south of the equator, providing first-time television to a substantial number of islands [and countries] now without any television. We hope it happens.**

THE TIDE CHANGES

I wanted to thank you for inviting me to participate in SPTS '80/Miami. The seminar was well organized and the participants seemed enthusiastic about the legitimate opportunities small aperture terminals and other associated delivery systems present. There were many interesting and probative questions asked and the next months and years will tell a great deal about the future of this new industry, and how regulations may develop around it.

John D. Pellegrin
1101 Seventeenth Street NW
Suite 904
Washington, D.C. 20036

John Pellegrin was one of two Washington communication attorneys on the program in Miami. His advice on the legal aspects of private TVRO reception plus his crystal ball gazing into the future of this area was much appreciated.

NO TV IN GUYANA

I read Bob Cooper's article in the IEE News of January 1980 and I am very much interested in having access to this new technology. Guyana has no television system and I have been attempting to gather information that would allow me to have this service here. We recently updated our INTELSAT terminal to 'Standard B' and the introduction of this system prompted my interest in private satellite TV reception. Can you help me in getting started?

Michael Welch
Guyana Telecommunications Corp.
Georgetown, Guyana

There are several countries along the northern edge of South America still without domestic (terrestrial) **TV service. The choices for reception are numerous; based upon the SPTS '80/Miami tests of INTELSAT with the Paraframe 5 meter antenna we now know that reception from BrazilSat is possible. Additionally, with the announcement that COMSTAR D-2** (parked at 95 degrees west) **will be placed into service this month for up to 11 additional channels of cable programming we have to observe that at least one set of six transponders** (out of the 24 on board) **bore-sight on Puerto Rico and the spillover from this shows** (according to FCC map data) **30/31 dBw footprint over Georgetown; not too shabby!**

A RECEIVER LICENSE TAX?

The concept that the reception of electromagnetic radiation is not an inherent right but rather one legislated by a Congress or agency (FCC) is quite common here in Europe. Many countries charge for a radio of television receiving license, which on the surface sounds like a tax on the equipment, but it is collected yearly like an operating tax. I believe that if the authorities in such countries were to locate a home built set that too would be taxed in a similar fashion. As an American stationed in Norway, I have that American belief that it is my 'right' to pluck anything out of the air that is radiated in my direction (and if they don't want me to try to demodulate what they **beam at me** then they can point their antenna in some other direction). I have considered the possibility of constructing a satellite receiving station here in Norway but would primarily be interested in English speaking programming. I don't know how much English is beamed via INTELSAT but rather doubt I am in a location where the U.S. DOMSATs could be received. However, if I did choose to put in such a system I too might have to fight as they tell me here such a station would be illegal also.

Richard D. Dunham (LAØCD)
Rege, Norway

Dunham's observations point up the importance of having a legal system such as we do have here in the United States; one that in this instance recognizes that reception is not regulated directly (i.e. through receiver-use taxation and licensing).

NFL IN SINGAPORE?

For about a year I have been trying to find out the location and programming possibilities for direct satellite reception here in Singapore. I have been told that the American Forces stationed at Clarke AFB in the Philippines receive the NFL games 'off the bird'. I later was told the signals are received in Manilla and fed by terrestrial microwave to Clarke.

We do have a few 'hard-core' sport fans here in Singapore who would hardly mind drinking beer at 3 AM some morning and catching the live football action from the states. Can you direct us in the right direction?

James L. Gauntt II (9V1SI)
Singapore

Here's a guess. One of the morale boosters the Armed Services have been trying is to upgrade the (home originated) **TV service at bases around the world. For years videotapes have been made by AFRTS and shipped into bases like Clarke where they are distributed either via base-located CATV systems or on occasion via a low power** (typically under 100 watt) **VHF channel transmitter. RCA is currently funded on a contract to find ways to feed live events** (such as NFL games) **into these spots since the Americans there are pleased but hardly overwhelmed by seeing TV shows that are a month or more old. As an interim measure we would not be surprised to learn that AFRTS was on occasion leasing INTELSAT transponder space to send selected events into areas such as Clarke. If this assumption** (and we label it as such) **is true that means that a suitably equipped private terminal could 'dial in' the same feeds. Perhaps a reader has more precise information?**

THE FOUNDER

As an incorporator of COMSAT (and virtually the only one who knew how a satellite system would work) I am delighted to

see the technically and economically feasible finally happening. Please send me your Satellite Study Package as described in the February issue of **RADIO ELECTRONICS**. Now, what is your forecast for scrambling?

B. Graham
Yucca Valley, CA 92284

It is amazing how many people who were influential with the founding days of COMSAT/INTELSAT have shown up recently. Several of Graham's early cohorts were seen at SPTS in Miami musing about how far and fast all of the satellite technology has changed in just a few short years. We keep saying that as more and more creative people get involved in this technology explosion nothing will be impossible long. Scrambling? That's another possible impossible!

FI + D2
MORE PROGRAMS OR MORE PROBLEMS?

THE CABLE NET II MYSTERY

As **CSD** reported in some depth in the February 1980 issue (see page P2) the loss of RCA's FIII spacecraft during the apogee kick motor firing in December has sent shivers through the entire cable industry. Most impacted were those new programmers who had intended to be on satellite by this time, through a re-shuffling of the FI and FIII transponders in an ultimate sequence only known to RCA.

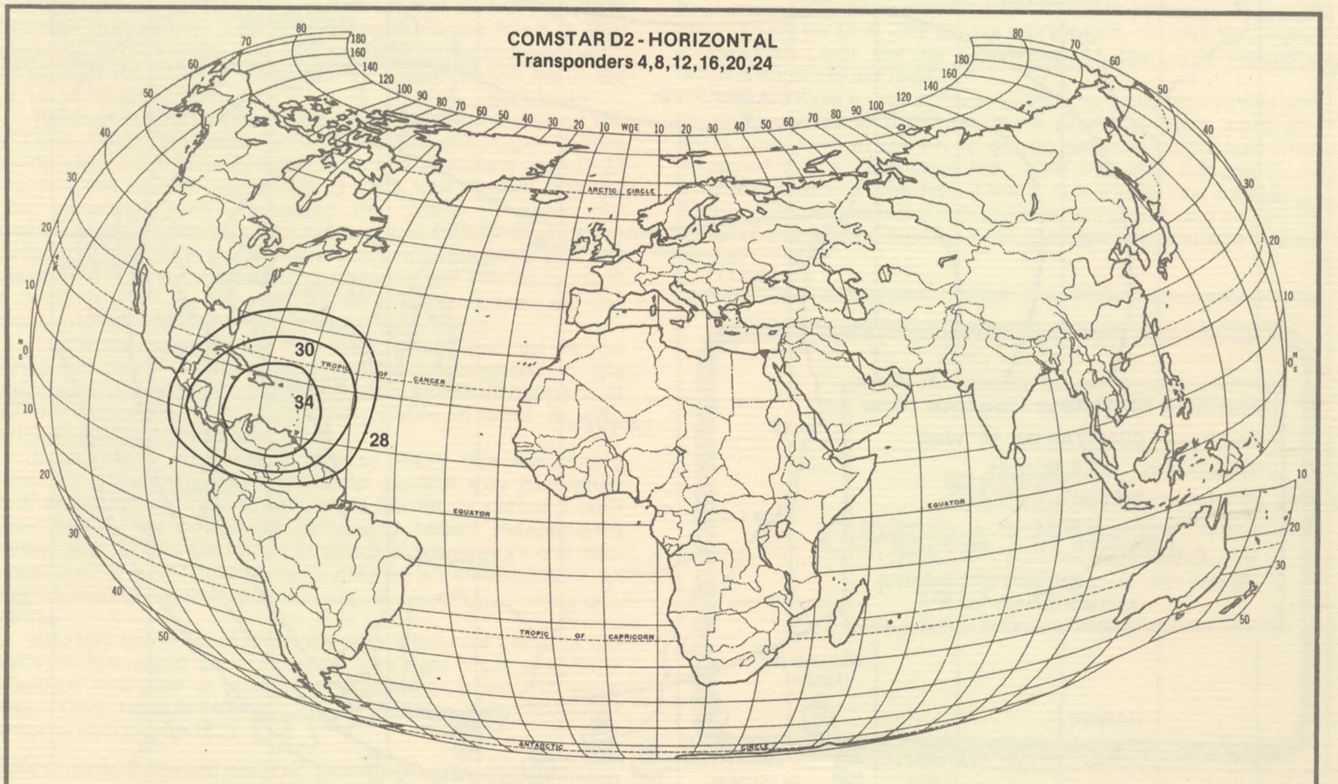
With the loss of FIII RCA was faced with a series of problems. They had (they reported) 11 additional cable programmers standing in line ready to launch their own programming on satellite, but with FIII lost, no place to put them. When the February **CSD** report was prepared the best bets suggested that RCA's FII spacecraft, located at 119 degrees west, would play a major role in the re-configured cable services. RCA, on their own apparently, had decided to call the second level of cable programmers ''Cable Net II''; to differentiate these new programmers from the established services currently on FI.

It was anticipated that RCA would do two things to get these 11 programmers operational:

1) **Move two data channels** now in operation on FI (transponders 15 and 19) off of FI to some other bird; thereby opening up two additional transponders for cable video services.
2) **And**, shift some of the FII transponder loading around off of RCA birds to perhaps other birds, thereby clearing FII for up to 11 channels of cable video.

Alas, for reasons again best known to RCA the decision has been made not to do either of these things. RCA said they could not clear transponders 15 and 19 on FI ''for security reasons''. ''Simply not suitable...''. And FII? ''Simply not suitable...''.

The alternative? RCA would ask ATT/GT&E to release ''up to 11 transponders on COMSTAR D-2 (located at 95 degrees west) for Cable Net II''. Now the ATT COMSTAR birds (which they lease from COMSAT) have at best been under utilized. Rehashing the speculation as to why ATT has



three separate 24 transponder birds in orbit but perhaps no more than the equivalent of 6 full transponders of traffic going through these birds is a waste of time. The facts, as released piece by piece to the FCC in January are clear enough; ATT simply is under utilizing their satellites. Additionally, there are apparently some serious problems with the satellites technically (although only ATT knows for sure). Furthermore ATT would like to launch a fourth COMSTAR; they would have liked to nail down a fourth in-orbit position with IV but now they may have to settle for merely replacing one of the exising birds with IV (probably D-1 at 128 degrees west).

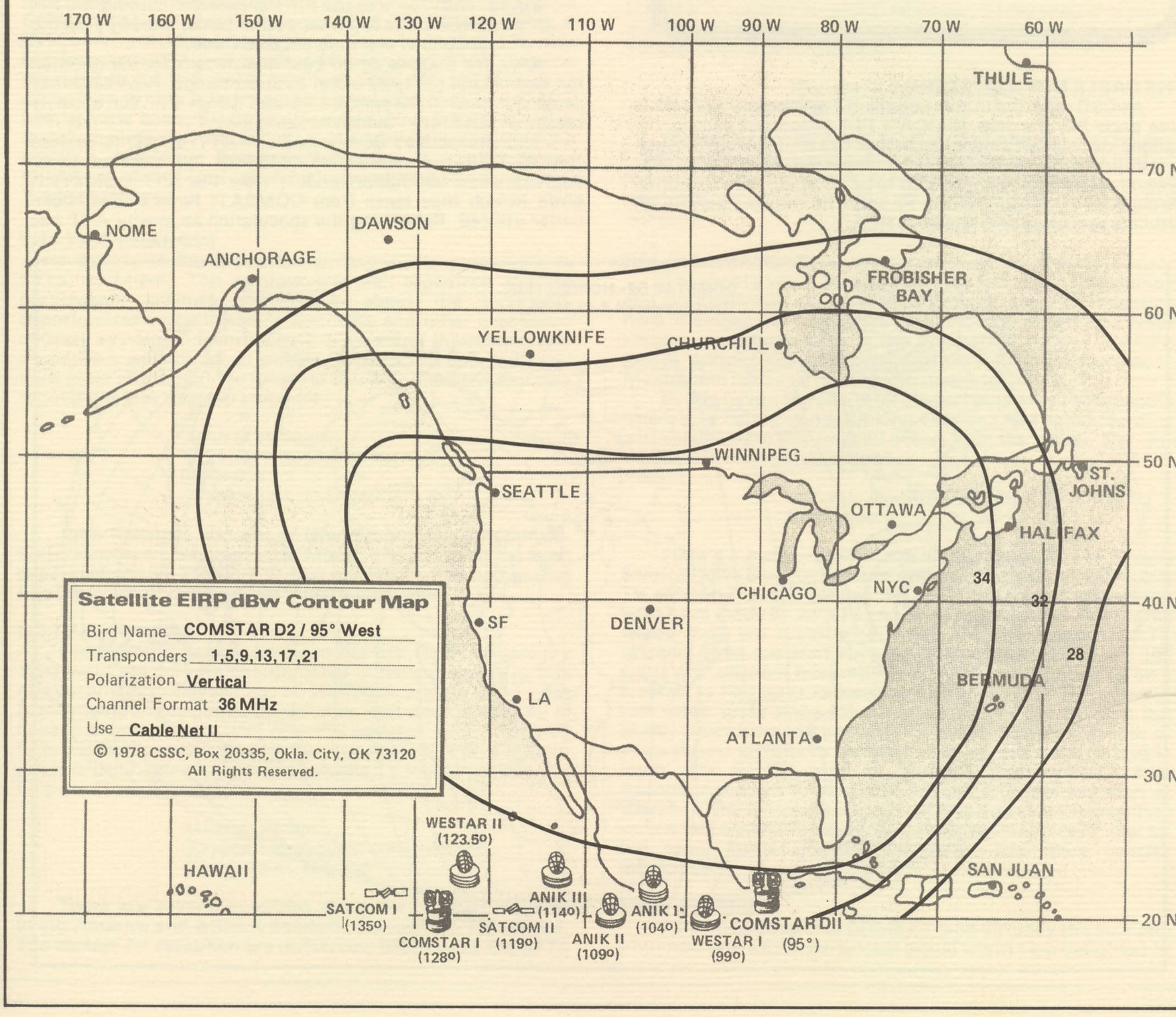
RCA asked ATT to sub-let to them 11 transponders which RCA would then re-sub-let to the cable industry. ATT could hardly say no; they had just admitted to the FCC that their satellites were at best lightly loaded with traffic.

But which D series bird would it be? D-1 at 128 degrees is (even ATT admits) suffering from serious powering and transponder problems. D-3 is the newest, located at 87 degrees, and nobody likes to give the keys to a brand new car to a competitor. That kind of suggested D-2 at 95 degrees.

However as our December 1979 **CSD** report detailed, COMSTAR birds have a unique approach to boresighting of their downlink transmit antennas. All D series birds are 24 channel; which means that like the RCA SATCOM birds 12 channels are linear vertical and 12 channels are linear horizontal. And, like the RCA birds, each bird has four downlink (or transmit) antennas with six of the transponders connected to each transmit antenna. Now the rub.

ATT, by design, has directed the boresight of each of the four transmit (downlink) antennas in a different direction. For example, as the on-file-at-the-FCC data shows, the present boresight configurations for D-2 are:

1) **Antenna group one** - boresighted on central USA (34 dBw line extends outside of US proper - **see map here**) for transponders 1,5,9,13,17 and 21 (vertical).
2) **Antenna group two** - boresighted on what would be Alaska...but unfortunately Alaska cannot be 'seen' from 95 degrees west so this pattern actually ends up in space (per the FCC on-file EIRP or footprint data). This entails transponders 3,7,11,15,19 and 23.
3) **Antenna group three** - boresighted on Hawaii with transponders 2,6,10,14,18 and 22. The EIRP is 34 dBw which is good news for Hawaii **if** the pattern is left alone (the present FI levels in Hawaii are in the 28-29 dBw region).
4) **Antenna group four** - boresighted on the Caribbean (San Juan) with a 34 dBw contour extending over everything from the Isthmus (i.e. Panama) on east to the far eastern Caribbean (**see map here**); horizontal on transponders 4,8,12,16,20 and 24.



This suggests that there are only six transponders (vertical set 1,5,9,13,17 and 21) which service the continental United States (or called CONUS). That sounds like bad news. However there is more to the mystery.

The Hughes built bird transmit antennas are deployed in their fixed positions at launch. There are two reflectors and four feeds. One **reflector** is positioned so that with the appropriate feed it can send boresighted signals to Alaska, Hawaii or CONUS while the second reflector is set up with its feeds so it can boresight on CONUS or Puerto Rico. And the feeds can be switched, by ground command. For example:

1) **The Alaskan beam** (which is really a 'space beam' since the bird cannot 'see' Alaska) can be brought back to boresight on CONUS proper, or into a half-way mode step where the boresight is sort of half way between Alaska and the U.S. That says that under this switched configuration transponders 1,3,5,7,9,11,13,15,17,19,21 and 23 (or **all** of the vertical channels) **could** in fact service CONUS (but not Alaska; the Alaskan's are simply not going to get service from D-2 unless they live in the far south of the state).
2) **The Puerto Rico** beam can be switched back to the mainland boresight as well, but in so doing they lose Caribbean coverage.
3) **The Hawaii beam** can also be switched back to CONUS but of course Hawaii is lost in the process.

Note that the horizontal transponders (2,4,6,8,10,12,14, 16,18,20,22 and 24) are either/or situations; either Hawaii **or** CONUS, or, Puerto Rico **or** CONUS.

Now, which of the 24 transponders on board are likely to be utilized for the 11 new Cable Net II services? One source reports ATT is offering to 'clear' 7 vertical and 4 horizontal transponders. Clearing 7 verticals seems quite simple; six are pre-designed for CONUS boresight and the other six are switchable back from the non-boresight of Alaska to CONUS. Which 7 will remain a guessing game until RCA and ATT and the would-be cable programmers who may or may not wish to be on D-2 all get together. The horizontal group of 4 forecast for cable is another mystery. Obviously someone (either Hawaii or Puerto Rico) is going to lose service in the process since when the boresight is switched back to CONUS the on-file boresight coverage goes away. The best speculation we have is that Hawaii will lose service and that says the 4 transponders ATT has offered for CONUS coverage on horizontal will be in the 2,6,10,14,18 and 22 group.

If this presumption is correct, what does that say about the liklihood that Caribbean area terminals will have decent quality video on relatively speaking small terminals from D-2? One Hughes source suggested to **CSD** that "there may be some surprises here", meaning that while **on paper** the boresights after switching will **not** help the central or southern Caribbean, that in the real world there may be some positive side effects. The same source suggested levels may be as much as 3 dB higher in the real world than on paper on the after-switched beams in the Caribbean. We'll see.

There was speculation that video would end up on the Caribbean beam and it would remain boresighted in the Caribbean. Let's squelch that one right now; if this happens, it will not be cable television video. Cable interest is with CONUS, not the Caribbean.

(Incidentally, D-1 and D-3 also share this switchable boresight capability. This may help explain why published EIRP maps for the COMSTAR birds do not correspond with observations; the published maps only reflect **independent** deployment of four separate boresights whereas in the real operational world the boresights may be all concentrated on CONUS as outlined here.)

Politics

Into this technical mish-mosh enters the real world of the needs of the cable programmers who saw their programs disappear in a poof of smoke last December when FIII went away. They have a number of bottom-line (i.e. financial) concerns including:

1) Unless there are several 'strong' programmers on D-2, the cable industry will not spend the money for a second TVRO antenna, LNA system (two LNAs since both polarizations are forecast for use), an ortho coupler (for separating vertical and horizontal signals into two separate downlines) and the usual bank of receivers (one per program channel to be carried).
2) If the programming sources on D-2 are 'weak' (i.e. largely appeal to 'minority interests') then D-2 programmers will flop; not enough cable systems are going to spend upwards of $15,000 per terminal (plus $2-3,000 per receiver).

Clearly what is needed on D-2 is some service that the majority of the cable systems are willing to spend money to receive. RCA knows this very well. That's why RCA has always been very careful about making its own transponder assignments and attempting to arrange the programming sources so that 'some biggie' is on each service offering. (The cable industry started off with all programming on **horizontal only** and when the number of services grew to the point where expansion to vertlal was required there was considerable speculation that cable systems would not invest in an ortho-coupler [$500 range] and a second LNA.)

It is in RCA's interests that Cable Net II have at least one 'biggie' on it. Something like HBO or WTBS. Unfortunately, the established biggies are not about to move. So one suspects that RCA looked at the additional 11 users to decide which one looked like a winner. Ted Turner's new Cable News Network fit the bill.

Turner, however, claims he was guaranteed, in a 1976 contract, access to the major cable bird. RCA and Turner are headed for court. Turner wants on SATCOM FI for his June start date of CNN in the worst way; simply because by being on the bird that all cable systems already have a TVRO antenna for, he is guaranteed the largest possible audience for CNN in the shortest possible time. RCA, **one suspects**, wants CNN on Cable Net II for the same reason; he will be attractive enough with CNN to drag cable firms into the second antenna business and with terminals in place for one D-2 transponder the rest of the programmers on D-2 will then have a fighting chance at getting their programming carried by a large number of cable systems.

The cable industry's reaction to the D-2 plan was explosive; only one supplier immediately indicated he **would** take a slot on D-2; the others were mum, or plainly angry. COMSTAR birds are not well known in the cable industry; what is known is not liked.

So we have a very confusing picture, both technically and politically. Clearly there are more would-be cable programmers chomping at the bit to get on satellite. RCA had it all wrapped up in a package the cable industry was ready to swallow until FIII was lost. Now it is a whole new ballgame. Some of the programmers might start programming on D-2 as early as this month (April). **Or they might not start at all.** Stay tuned!

BIRD OPERATIONAL NOTES

SERVICE to Virgin Islands (US) via SATCOM FI for WTBS has been approved by FCC. All US domestic satellites

must go through location by location approval procedure for any receiving sites **outside of** US proper. Puerto Rico had been previously approved.

VCI SATELLITE which had been scheduled to begin feeding up to 12 hours per day of movies for 'off-shore oil rigs' and other 'remote sites' via WESTAR III back on January 1 now says they plan to start in June. **Newest twist** - they will multiplex two video signals onto single transponder (plus have four audio subcarriers) in move they characterize as 'insuring that only paid subscribers will receive signal'. Whether service will utilize split transponder (i.e. a pair of 17.5 MHz channels within a single transponder) or interlaced field system (i.e. alternate lines for each video signal) is unclear although latter approach typically requires $20,000 'decoder' at **each** receive site.

COMSAT plan to create with Sears direct to home pay satellite system seems to be 'delayed' at FCC; plan to hit FCC with full blown details in March didn't come off.

MICROWAVE ASSOCIATES (M/A-Com) may be next 'major supplier' to jump into the low-cost (as in private) home terminal market. Noises about "$6,000 compete home terminals" have surfaced of late with some in firm speculating such terminals will be available by end of this year. Primary interest here is the firm's $150 million dollar range annual sales in microwave hardware and components and their demonstrated ability to deliver reasonably large quantities of hardware.

RCA has dedicated a new uplink site in Los Angeles area for feeding of video and audio programming into satellites that will ultimately carry programming to US bases and other locations outside of USA (AFRTS).

HBO's transponder 20 on SATCOM FI carried extensive video and audio on recently completed Lake Placid Olympic games to west coast where COMSAT earth station beamed them on to INTELSAT FIV-A (8) located at 174 degrees east for delivery to NHK Tokyo. Viewers who stumbled across feed were probably unnerved by Japanese language audio on some transmissions!

SPTS '80/Miami delegate who left west coast carrying proto-type Tay Howard receiver (see page T3 of March **CSD**), 10 foot 'expanded' Chaparral dish and 120 degree LNA to 'test' reception possibilities at various Pacific island sites hit paydirt at one stop. Terminal set up in Marshall Islands produced good quality pictures from INTELSAT transponder 12 (174 degrees east; virtually overhead) operating on 1/2 transponder format. Later stop at Nauru produced less satisfactory results but reception was possible even there. Next step will be improved system and better defining of INTELSAT footprints available throughout Pacific area west to Australia.

A motel in Virginia Beach, Virginia (Princess Anne Inn) is receiving plenty of publicity in trade publications because of its earth terminal. Motel operator claims he is able to maintain full or near full status during normally quiet weekends in winter because he offers HBO, SHOWTIME, Movie Channel, and other selected satellite fed events. Innkeeper Scott Sterling reports his fame has spread to point he now spends large portion of day answering telephone and letter inquiries from other motel operators throughout North America.

APPARENTLY first operational UHF TV translator fed direclty by satellite went into operation in Denver recently; carrying Spanish International Network (SIN) feed from WESTAR II. They are calling system (which has 5 meter dish) a 'Satellator Station'.

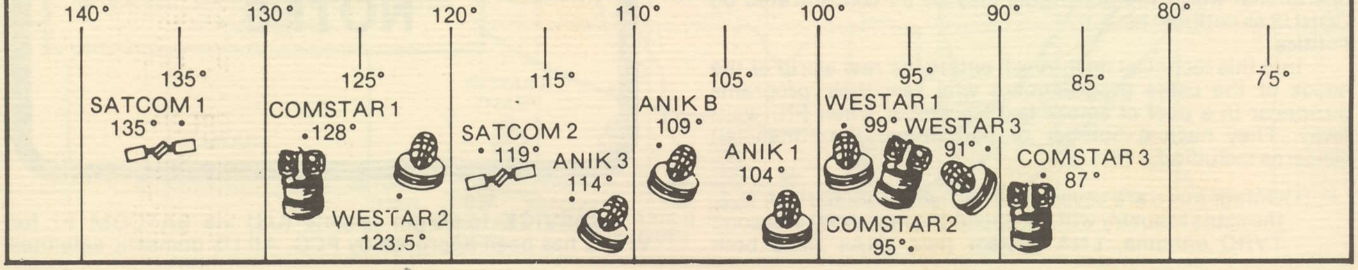
UNITED NATIONS starting to focus on 'questions presented' by direct to home broadcasting. Two issues seem at stake at this point: (1)determining who owns air rights over equator (some nations in South America claim their 'rights' extend straight up forever), and, (2)deciding how one nation's domestic broadcasts will be kept out of adjacent nations. Soviets and a few others are demanding that agreements to be worked out prohibit one nation from allowing its signals to be picked up in other nations. Interesting position for Russians who utilize inclined Molniya orbit apogee over top of Canada to spit television back over the top of North Pole into Orbita receiving terminals; (**CSD**, 2/80) when said transmissions are clearly receivable over most of US and Canada!

BY JUNE it is expected that first regular uplinks from Washington, D.C. will be in operation. System will use C-SPAN site and parts of terminal and allow broadcast stations and others to start taking direct news feeds from DC correspondents, others, for local airplay.

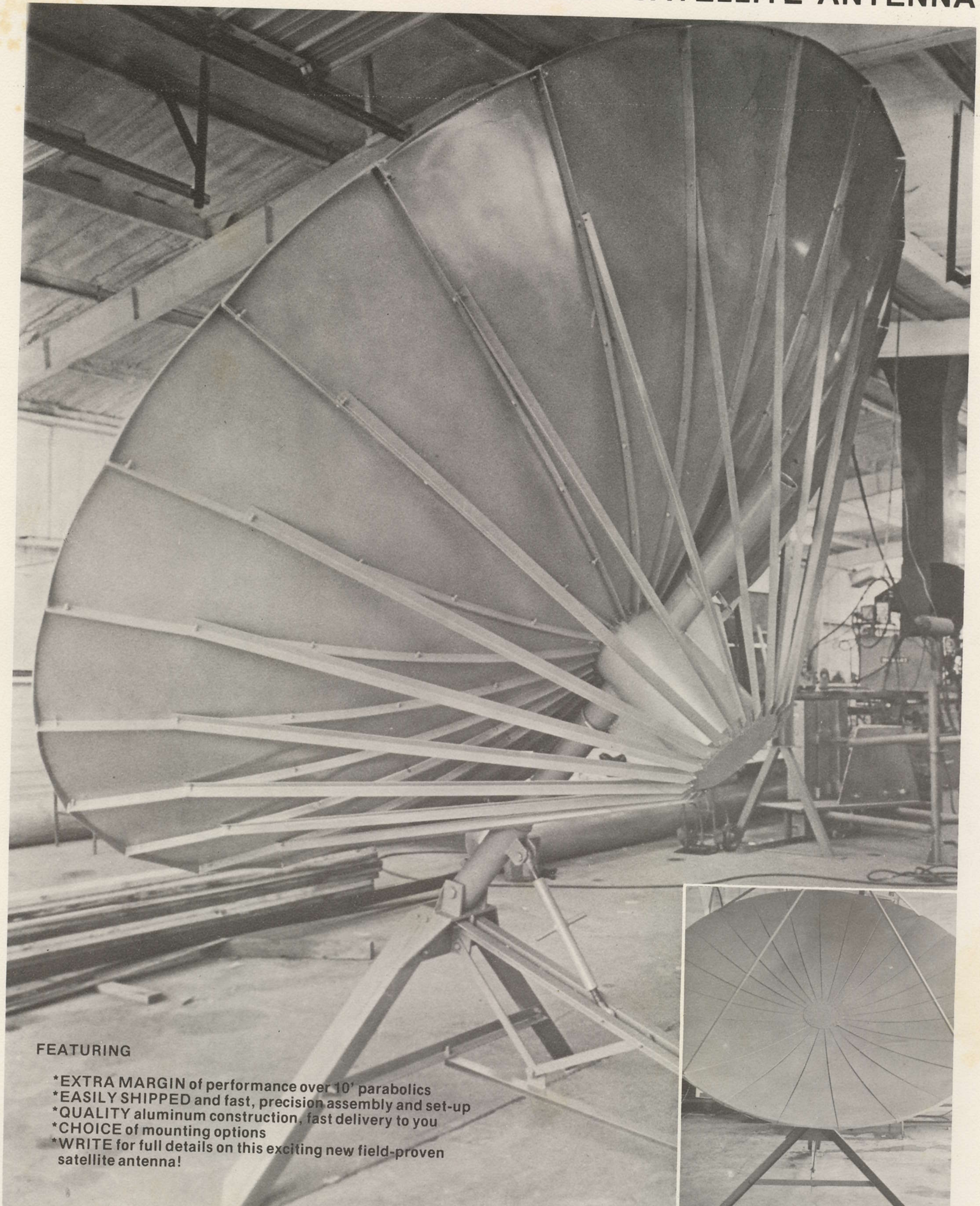
MEXICO has started expanded use of WESTAR II; SIN now carries around 12 hours per day for US affiliated stations. **New use** is for movies, sports, novellas and other network programming for Mexico City's XEW. Apparently Mexican TV stations are now getting some direct feeds via WESTAR II. Bottom line is that WESTAR II has a **pair** of Spanish language program channels now operational.

Quick-Satellite-Facts: Audio subcarriers currently in use on SATCOM FI are as follows. Transponder **3** - WFMT (stereo clasical music) is on 5.8 MHz. Transponder **6** - UPI News and Slow Scan is on 6.2 MHz while Easy Listening Music is on 7.4 MHz. Transponder **21** - The Disco Network is on 5.8 MHz while Seeburg Background Music is on 7.4 MHz. **Program control tones** are as follows: Transponder **5** (Movie Channel) turns on east/central receivers with 311 * # and west with 519 * #. Transponder **9** (Madison Square Garden Sports) turns on with 438 * #; Calliope turns on with 168 * #; C-SPAN turns on with 195 * #; and, BET (Black Entertainment Television) turns on with 018 * #. Transponder **10** (Showtime) turns on with 576 * #. Transponder **11** (Nickelodeon) turns on with 749 * #. Tranponder **12** (Showtime) turns on with 576 * #. The Mini-Pay service (Front Row) on transponders 10 and 12 turns on with 481 * #. On transponder **21** SPN utilizes 429 * # while HTN (Home Theater Network, 8-10 PM eastern) utilizes 207 * #. On transponder **22** Modern Satellite Network utilizes 421 * # while HBO (west) utilizes 835 *#. On transponder **23** (HBO's Take-2), they use 529 * # for the eastern two time zones and 681 * # for the western two times zones. Transponder **24** (HBO east) utilizes 835 * #. RCA owned and operated uplinks include Atlanta (not supposed to have video although it has been seen). Vernon Valley (N.J.), Chicago (Lake Geneva), Los Angeles (South Mountain), San Francisco (Point Arena), and Houston. Western Union owned and operated uplinks include Glenwood (N.J.), Chicago (Lake Geneva), Los Angeles, San Francisco, Dallas, Seattle, Phoenix, Atlanta and Honolulu. ATT-GTE uplinks include New York City, Chicago, Tampa, Atlanta, Honolulu, San Francisco and Los Angeles. PBS uplinks include Washington, D.C., Denver, Columbia (S.C.), Lincoln (NB), Hartford (CT) and Talahassee (FL). Independent uplinks include Appalachian Regional Commission (Lexington, KY), C-SPAN (Washington, D.C.), ESPN (Bristol, CT.), Southern Satellite Systems (Atlanta, GA), SIN/Galavision (Los Angeles), CBN (Virginia Beach, VA), PTL (Charlotte, NC), Satellite Systems (Buffalo, NY), KTBN/Trinity (Los Angeles and SIN) San Antonio, TX).

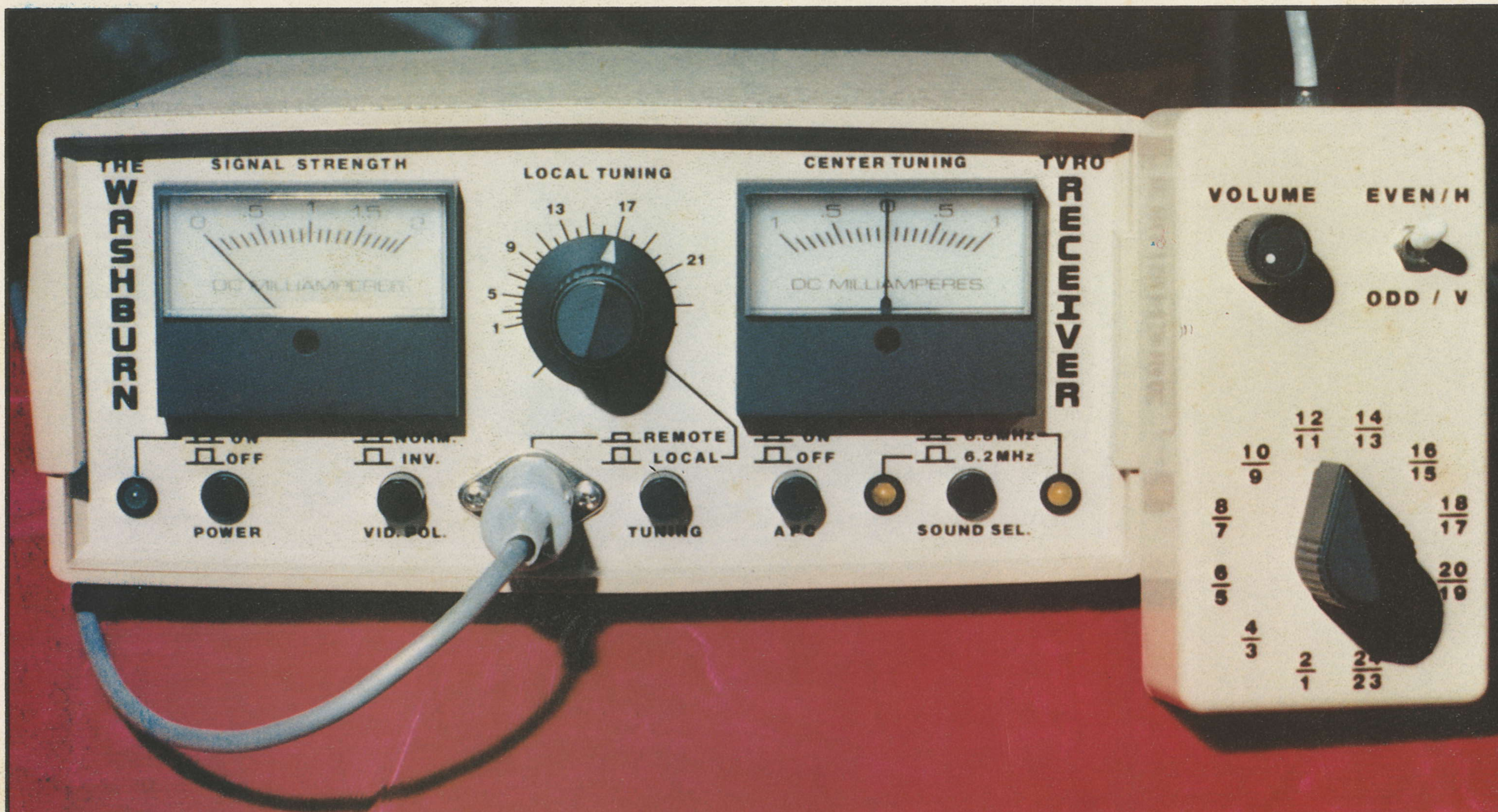
WHERE THE BIRDS ARE...



INTRODUCING: ADM's ELEVEN FOOT SATELLITE ANTENNA



ANTENNA DEVELOPMENT AND MANUFACTURING, INC.
2745 Bedoll Av., P. O. Box 1178, Poplar Bluff, Mo. 63901
Telephone (314)785-5988


THE WASHBURN
SIGNAL STRENGTH
LOCAL TUNING
CENTER TUNING
TVRO RECEIVER
DC MILLIAMPERES
REMOTE
LOCAL
OFF
INV.
6.2MHz
POWER
SOUND SEL.
VOLUME
EVEN/H
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